"Yorcalbro"

REGISTERED UNDER B.N.F. PATENT No. 308647, 1929.

THE MOST ECONOMICAL CONDENSER TUBE IN THE WORLD.

TUBES

IN BRASS, COPPER, ALUMINIUM, CUPRO NICKEL, PHOSPHOR BRONZE, ALUMINIUM BRASS, and all Non-Ferrous ALLOYS - - - - -

CONTRACTORS TO THE ADMIRALTY AND ALL GOVERNMENT DEPTS.

THE YORKSHIRE COPPER WORKS LTD.

LONDON: 53, NEW BROAD ST., E.C.2 **LEEDS, ENGLAND** GLASGOW: 78, McALPINE STREET

Telephone: 75431 (P.B.Ex.). Telegrams: "Tubes," Leeds.

COMPACT RELIABILITY

Continue to enjoy all the advantages of D.C. Mains. Operate your D.C. Plant direct from the A.C. Mains by means of a Westinghouse Metal Rectifier. No moving parts . . . no replacements . . . no foundations.

WESTINGHOUSE METAL RECTIFIERS

THE WESTINGHOUSE BRAKE & SAXBY SIGNAL CO., LTD.

82, YORK ROAD, KING'S CROSS, LONDON, N.1.
Telephone: North 2415.

INSULATED WIRE UNAFFECTED BY SEVERE TEMPERATURE RISES

No thicker than cotton-covered wire—yet insulated with pure Asbestos Fibre!

LEWBESTOS insulated wire is unequalled—

for use in the manufacture and repair of coils for traction, mining and mill motors; lifting magnets and all apparatus subject to severe temperature rises.

Withstands a test pressure of 1,000 Volts between turns after long period working up to 200° C. (392° F.)

LEWBESTOS insulation is a pure Asbestos Fibre Insulation specially treated to remove all impurities, and it is moisture-proof and tough, but in spite of its toughness it will not crack or break on sharp bends.

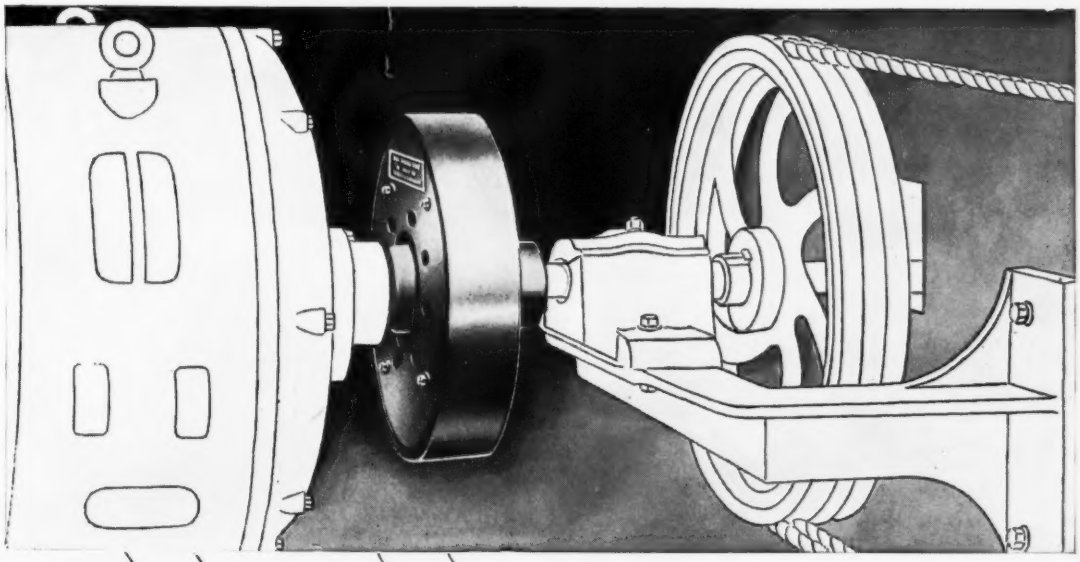
THE LONDON ELECTRIC WIRE COMPANY AND SMITHS LTD. · LEW · REGISTERED

LEWBESTOS Regd

PURE ASBESTOS FIBRE INSULATION

THE LONDON ELECTRIC WIRE COMPANY AND SMITHS, LTD.,
Church Road, Leyton, London, E.10.

Telephone: LEYTONSTONE 3636.
Telegrams: LEWCOS, LONDON.



BROADBENT

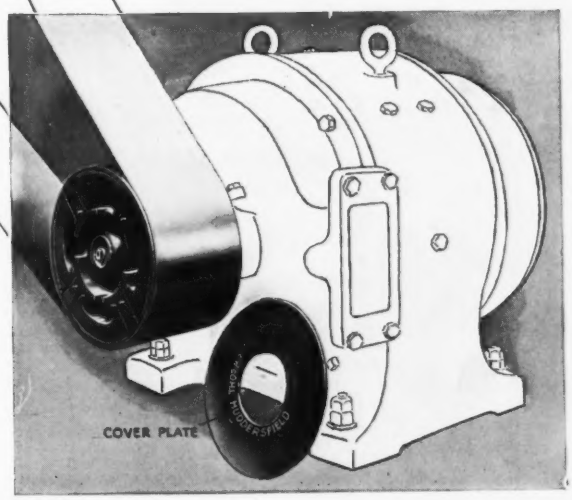
PATENT AUTOMATC

CLUTCHES

SAVE POUNDS A YEAR
IN CURRENT

ENSURE
EASY
STARTING
OF MOTORS
WITH
REDUCED
CONSUMPTION
OF CURRENT

NEW TECHNICAL CATALOGUE
POST FREE.



THOMAS BROADBENT
& SONS, LTD.
HUDDERSFIELD
Telephone : Huddersfield 1581 (4 lines)
Telegrams and Cables : Broadbent, Huddersfield

STEEL SHEETS

FOR ALL PURPOSES

We can supply your requirements immediately from stock at the lowest possible prices.
——Highest quality only.——

SHEETS SPECIALLY SHEARED FOR CUSTOMERS' REQUIREMENTS DOWN TO 3".

STEEL, PLAIN & CHEQUERED PLATES
STEEL SECTIONS · IRON & STEEL
MERCHANT BARS · FLITCH PLATES
HOOPS, ETC.

Full range of sizes and large tonnages always in stock.

MONTHLY STOCK LIST MAILED ON APPLICATION.

HALL BROS (West Bromwich) LTD.
EAGLE WORKS · GREETS GREEN
WEST BROMWICH

Telephone: No Tipton 1611 (5 lines).

Telegrams: Eagle, West Bromwich.

"BAKELAQUE" INSULATION

Highest Grade BAKELITE Having LOWEST POWER losses and the HIGHEST ELECTRIC STRENGTH VALUES KNOWN.

We have produced an Improved Synthetic Resin at our Riverside Works, which we describe as Number F. 818. Tests made September, 1932, by the Metropolitan-Vickers Research Department, Manchester, on tubes made up by them show the following result :—

			In Oil at 25° C.		In Oil at 90° C.	
	I.D.	Wall Thickness.	k.V.	v/mil.	k.V.	v/mil.
TUBES	1"	0.126	95	754	72	572
	2"	0.128	61	476	63	492

Dielectric losses after soaking in oil for 2 days at 40° to 90° C.

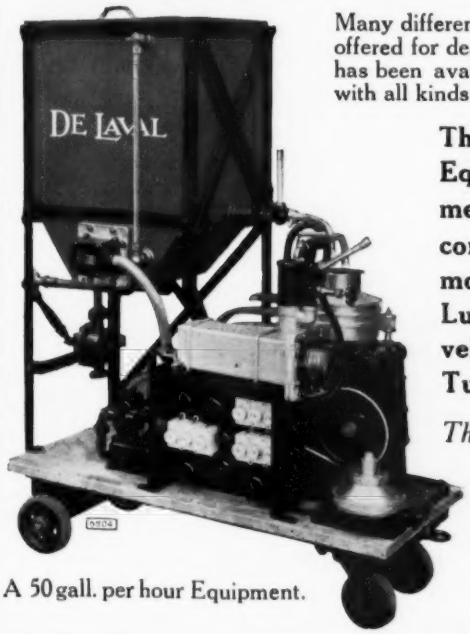
	Results obtained at 90° C.		
Applied k.V. Stress.	Capacitance m.m.f.	Tan d.	S.I.K.
5	1723	0.027	3.7
10	1723	0.027	

We shall be pleased to receive enquiries for :

VARNISH, VARNISHED PAPER, TUBES and SHEETS
Made up from above.

ATTWATER & SONS, PRESTON, ENGLAND.

DE LAVAL UNIVERSAL OIL PURIFYING EQUIPMENT



A 50 gall. per hour Equipment.

Many different types of Oil Purifying Equipments have been offered for dealing with different types of oil but no equipment has been available which will give equally satisfactory results with all kinds of oil.

The De Laval Universal Oil Purifying Equipment has been specially designed to meet this need and can be used for the complete purification, including the removal of colloidal carbon, of Diesel Engine Lubricating Oil, Crankcase Oil from motor vehicles, Transformer Oil, Switch Oil, Turbine Oil, Fuel Oil, etc.

These equipments are available in two sizes having a capacity of 50 *and* 100 *gallons per hour.*

Prices and full particulars sent upon request to:

ALFA-LAVAL CO. LTD.,
34, Millbank, London, S.W.1.

BEHIND THIS TRADE MARK LIE

60 YEARS EXPERIENCE OF ELECTRICAL PORCELAINS

Miles and miles of transmission line insulation carries this mark. It is moulded into thousands of heating and lighting accessories. Porcelains of all types are branded with it.

Its success is built on a progressive experience. Years of experiment have taught us the highest standards of Strength, Accuracy and Economy in output.

Porcelain is still the hardiest and safest insulating medium. 'TT.' porcelain is, from every point of view, in the highest class.

We make a complete range of porcelains for electrical use:—

Overhead H.T. Insulators
Post Office Insulators
Post Type Insulators

Refractories
Fire Bars

Porcelains for Accessories of every kind

"Fish Spine" Beads for bare wire insulation

TAYLOR TUNNICLIFF PORCELAINS

INSULATORS .. REFRACTORIES .. CHINAS .. BEADS

TAYLOR TUNNICLIFF & CO., LTD., 110 CANNON ST., LONDON, E.C.4.—Telephones - Mansion House 7211 and 7212

"SILVERTOWN" OILS

FOR

LUBRICATION

AND

INSULATION.

SLL

SLL

TRANSFORMER OILS to B.S.S. 148/1927

In bulk ex road or rail tankers and in drums.

"PENETROL" (Regd) HEAVY INSULATING OILS for Switchgear

Delivered electrically dry in bulk or drums.

AN AERIAL VIEW OF OUR WORKS AT SILVERTOWN

Oils for THERMAL STORAGE HEATING PLANTS

Non-carbonising.

LUBRICATING OILS for DIESEL ENGINES, TURBINES, & MACHINERY of all kinds.

Contractors to The English Electric Co., Ltd., and Principal Government Departments, Railways, Municipal Authorities and Industrial Firms.

Silvertown Lubricants SLL LTD.

MINOCO WHARF,

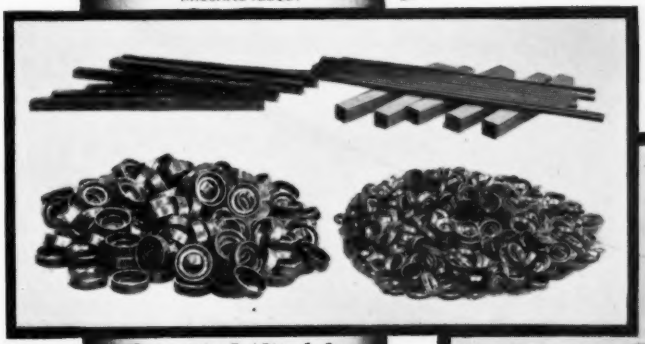
WEST SILVERTOWN, LONDON, E.16.

PERFECT MICANITE INSULATOR

Round and Rectangular Micanite Tubes.

BRITISH MICANITE MADE

BUILT-UP MICA INSULATION IN EVERY FORM REQUIRED BY THE ELECTRICAL INDUSTRY

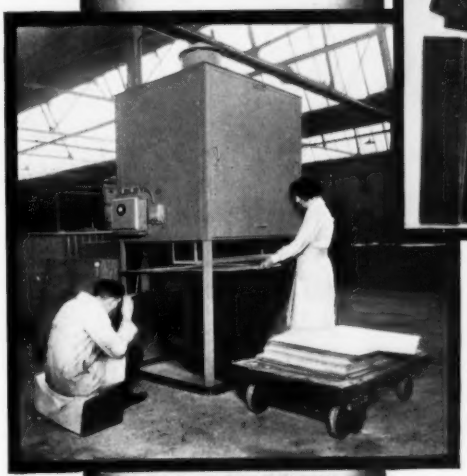


Commutator End Rings for Car Lighting and Starting Sets and for Fractional H.P. Motors.

Sheets
in all qualities
Rings
Tubes
Troughs
Tapes, etc.

Commutator End Rings.

Commutator Micanite Segment Separators and Heat Resisting Micanite Plates for Electric Irons, Rheostats, etc.



X-Ray Examination of Micanite Sheets to Ensure Freedom from Metallic Particles.

Micanite is manufactured at the Empire Works, Walthamstow, in every form required by the Electrical industry, including :—

Commutator Micanite milled to close thickness limits in standard size sheets or as segment separators ready cut to size.

Hard Micanite Board for machining into washers, bases, etc.

Moulding Micanite in sheets for hot moulding into troughs and other shaped pieces.

Flexible Micanite which can be bent cold for armature slots, field coils, magnet cores, etc. (*a*) in sheets without reinforcement (*b*) reinforced with paper.

Micanite Cloth and Micanite Silk in sheets and rolls, for slot insulation and as tape for armature and stator coils.

Micafolium. A thin shellac-treated paper base, on to which Mica Splittings are built for wrapping stator and armature bars.

Heat-Resisting Micanite for heater elements, such as electric irons and kettles, and for rheostat work.

Micanite Rings and Tubes, supplied as commutator end rings, stator tubes and slot linings of all shapes, bobbins and tubes of circular, oval or square section.

Micanite Washers, Discs, Plates and Machined Pieces.

PERFECT MICANITE INSULATOR

THE MICANITE & INSULATORS COMPANY LIMITED

MIC

EMPIRE WORKS, BLACKHORSE LANE, WALTHAMSTOW, LONDON, E.17

Electrical Insulation Engineers and Manufacturers

E. N. MASON & SONS LIMITED

THE MANUFACTURING DRAWING OFFICE STATIONERS

Every one of these sample Books is of vital interest to the:—

ENGINEER
DRAUGHTSMAN
ARCHITECT
& SURVEYOR

Because:—

THEY REPRESENT THE BEST VALUE OBTAINABLE AND ARE A SURE GUIDE TO ECONOMY WITH ENTIRE SATISFACTION

SAMPLE BOOK.

No. 1. Tracing Cloths.
,, 2. Prepared Tracing Papers
,, 3. Photo Printing Service.
,, 4. } Parchment and
,, 4A. } Detail Papers.
,, 5. Cartridge Drawing Paper.
,, 6. Fine Machine and Handmade Drawing Papers.
,, 9. Sectional Drawing Papers and Linen.
,, 10. Ferro Gallic Materials.
11. Ferro Prussiate Materials.
,, 12. Architects' and Surveyors' Ruled Papers.
,, 15. Nulyne Positive Photo Process.

300 Qualities for your selection.

It will cost you nothing to investigate our claims and we shall be happy to furnish copies of any of the above in which you are interested. We serve to satisfy and to establish a permanent goodwill.

ARCLIGHT WORKS, COLCHESTER, ENGLAND.

LONDON — BIRMINGHAM — MANCHESTER — NEWCASTLE-ON-TYNE.

T.P. 11

MIDLAND STEEL Co., LTD.

— REGISTERED OFFICE —
WEDNESFIELD, Nr. WOLVERHAMPTON

Manufacturers of

BLACK SHEETS, CLOSE ANNEALED SHEETS, CR. & CA. SHEETS, PATENT FLATTENED SHEETS, PICKLED SHEETS, PLATES, $\frac{1}{4}$" THICK & UNDER, CIRCLES, Etc. ALSO SPECIAL DEEP STAMPING & WELDING QUALITY.

— WORKS —

WEDNESFIELD STEEL CO.,
WEDNESFIELD, Nr. WOLVERHAMPTON.
Phone: FALLINGS PARK 31375.

MIDLAND SHEET CO.,
BRICKHOUSE WORKS, WEST BROMWICH.
Phone: TIPTON 1530.

B

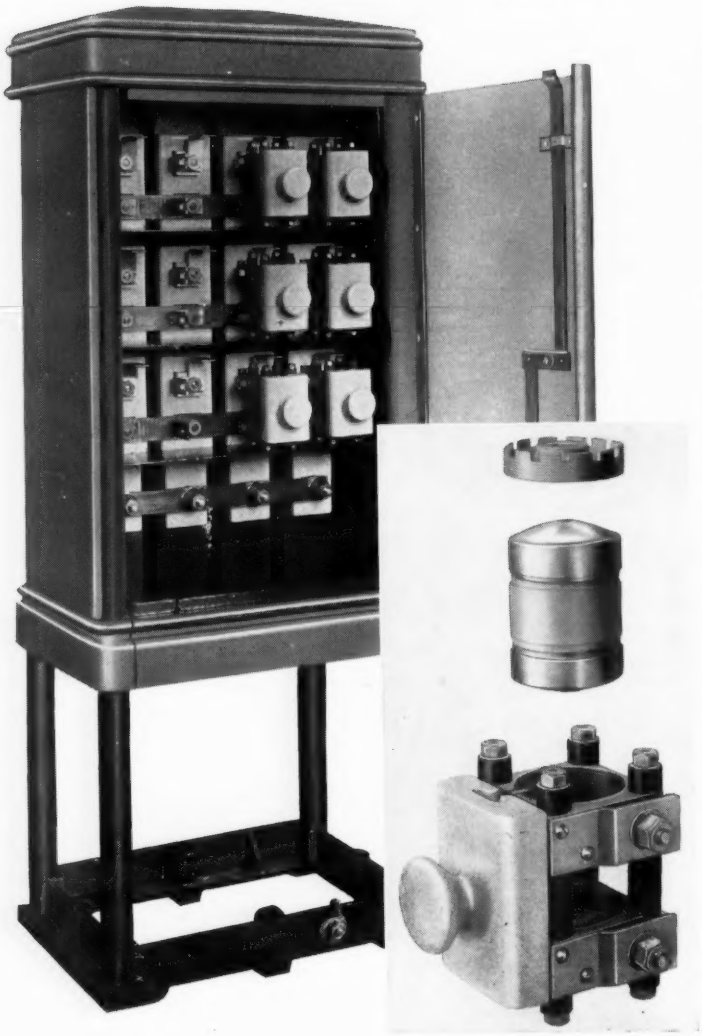
LATEST TYPE

SIEMENS

UNIT

FEEDER PILLAR

(PATENT NO. 28502)



Outstanding Features:

1. Cast-Iron Root, Plinth and Canopy, with Sheet Steel Body and Doors.
2. Robust 1¼" Steel Corner Posts giving complete rigidity, and on which the doors are hung, allowing easy and level swinging, irrespective of the weight of the door.
3. "English Electric" Cartridge Fuses up to 700 amps. Guaranteed rupturing capacity 25,000 k.V.A.
4. Cast-Iron Units fitted with porcelain bases for supporting the fittings.
5. Height above ground 3 ft. 6 ins.

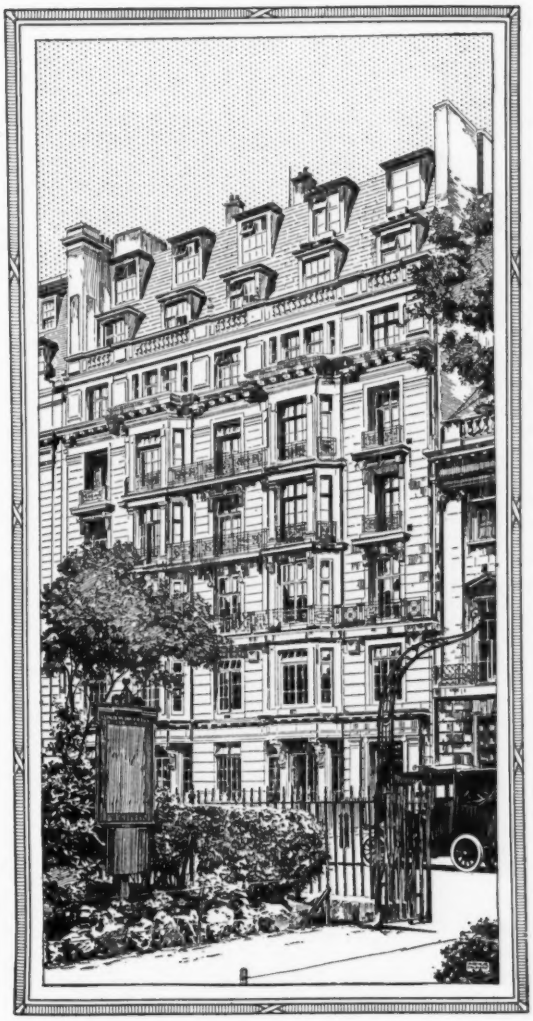
"CARTRIDGE" FUSE & HOLDER.

Note the spring contact on side which can be bolted up after the Fuse is in position, guarding against loosening by vibration and ensuring a perfect contact at all times.

Particulars from the Manufacturers.

SIEMENS BROTHERS & CO., LTD., WOOLWICH, LONDON, S.E.18.
Telephone: Woolwich 1161.

The ENGLISH ELECTRIC JOURNAL



Queen's House from Lincoln's Inn Fields.

All rights of republication, including translation of articles, are reserved.

British Industries Fair, Birmingham, 1933.

The Exhibits of The English Electric Company Limited.

Top :—The small stand showing the Domestic Heating & Cooking Appliances.

Bottom :—The large stand showing the Electrical & Mechanical products.

The English Electric Journal

Vol. VI. No. 4 JANUARY/MARCH, 1933 One Shilling.

CONTENTS

	PAGE
"English Electric" Medium-Speed Oil Engine - -	89
Slough Estates Limited; Extension of Power Station	99
Shipment of Large Armature to South Africa - -	105
The "English Electric" Exhibit at the British Industries Fair - - - -	106
"English Electric" Cookers	109
"English Electric" Motors; Some New Developments	112

All Communications respecting Editorial Contents should be addressed to The Editor, The English Electric Journal, The English Electric Company Limited, Stafford

EDITORIAL.

A new Medium Speed Diesel Engine is illustrated and described in this issue. A product of our Willans Works, Rugby, it represents the latest development in this particular type of engine.

More than 40 years have past since the introduction of the Willans High Speed Central Valve engine ushered in a new era of development and progress in the manufacture of prime movers. In the intervening years the Rugby Works have witnessed the development of the steam turbine, the Diesel engine, and the water turbine, and have taken an active part in the progress of each of these classes of prime movers. As the old Willans central-valve engine gave way before the steam turbine, the latter was taken up and developed through all its stages, until to-day this type of power unit is manufactured in all sizes ranging from the smallest to

the largest units now required in central station practice. The advent of the Diesel engine meant an expansion of the Company's activities, for the new engine was taken up and developed concurrently with the steam turbine, and was followed later by the Fullagar opposed piston type for land service.

The Company is in the unique position of manufacturing all classes of prime movers, and can place at the disposal of customers and their engineers, knowledge and experience which is obviously without bias in favour of any one type. Add to this the Company's ability to produce the whole range of electrical generating and distributing plant and it will be realised that advice and service can be given in connection with any problem relating to the generation of power, and its control, distribution, and utilisation.

The new "K" type engine is the latest addition to oil engines made by the Company, and represents the most recent practice and design in engines of medium speed. Designed to run at 600 r.p.m., it is manufactured in six sizes, having 3 to 8 cylinders, and developing from 150 H.P. to 400 H.P. respectively.

The next article in this issue deals fully with a turbo-alternator plant that the Company recently supplied to the Slough Estates Ltd. This plant is representative of the latest practice in steam turbine design, and will, we think, be found to contain many points of interest.

The British Industries Fair needs no introduction to our readers. Let it suffice to remark here that the exhibit of the Company at Castle Bromwich, Birmingham, from February 20th to March 3rd, was, within the limits of space available, a representative collection of the products of the Company. The description herein is of necessity incomplete and is only devoted to some of the Company's more recent developments. One section, however, that devoted to High Rupturing Capacity Fuse Gear, we hope to deal with at length in a succeeding issue, as this class of gear is becoming an increasingly important branch of our manufacture.

The industrial motors on view at the Exhibition presented many improvements in design and construction, and we have deemed them worthy of a more detailed description. They form the subject of a separate article which will be concluded in the next issue.

The De-Luxe Cookers, manufactured by the Company's Bradford Works, are dealt with not so much as a part of the Exhibition, but as a separate product because of the interest they are arousing in the field of Domestic appliances. This is the first time they have been reviewed in these pages, and the article, brief as it is, shows that here also, as in all their products, the Company has developed an article representative of all that is best of modern practice and methods of production.

"English Electric" Medium-Speed Oil Engine.

(Reprinted from "The Engineer," February 10th, 1933.)

The new six-cylinder medium-speed oil engine described and illustrated in the following article was designed and built at the Willans works of the English Electric Company, Ltd., Rugby. We recently inspected it on the test bed shortly before it was dispatched to Birmingham, where, at the British Industries Fair, it will form part of a larger exhibit of the products of the firm's Rugby, Stafford, and Bradford works.

The new design is one of the larger units in a new range of "K" type oil engines, with an output of 50 B.H.P. per cylinder, which is being constructed in three to eight cylinders, embracing powers of 150 to 400 B.H.P., all the engines having a running speed of 600 r.p.m. The firm is also building a similar range of 125 B.H.P. per cylinder "L" type engines, giving outputs of 375 up to 1,000 B.H.P. at 375 r.p.m. During our visit to Rugby we saw parts going through the shops for four 750 B.H.P. engines of this type, which are being supplied for the new Midland Regional Broadcasting Station at Wychbold, near Droitwich.

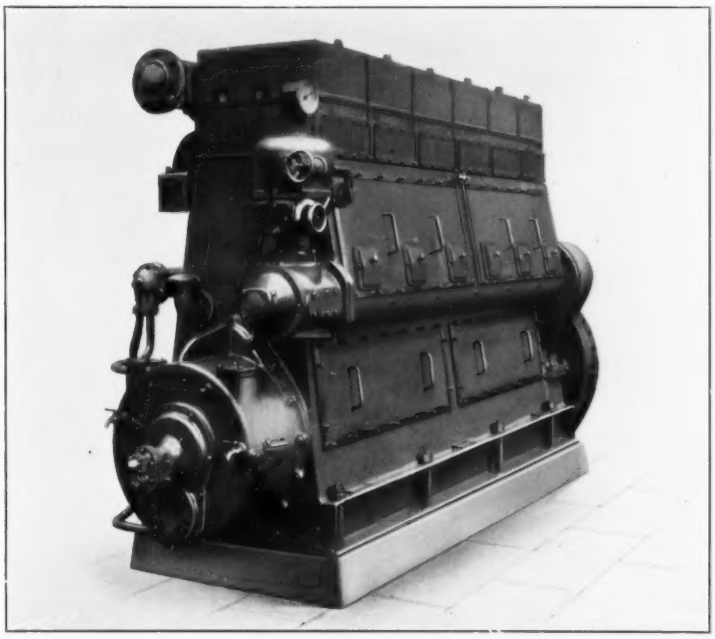


Fig. 1—View of 6-Cylinder Type K Engine.

Framing and Running Parts.

The new 300 B.H.P. engine has six 10 in. bore cylinders, with a stroke of 12 in., and is designed to develop full power at 600 r.p.m. The two views, Figs. 1 and 3, and the sectional drawings reproduced in Fig. 2, clearly show the very clean lines and the compactness of the design. It has a combined bedplate and crank chamber built up of rolled steel sections and plates welded together, so as to form a single unit, with the necessary strength and stiffness. The housings for the crank shaft journal bearings are made of cast steel, and are registered and welded to the lower transverse members of the bedplate. The engine is completely enclosed, but access to the principal parts is given by large-sized inspection doors, which are light and can be conveniently handled. The structural strength of both the framing and the principal running parts is in accordance with the requirements of Lloyd's Register of Shipping, and the design has been approved by that authority, whilst the engine rating conforms to the B.S.I. specification. British materials have been used throughout, and when in actual production the fuel pumps employed will be built in this country. The drawings, Fig. 2 (a and b), clearly show the fabricated construction of the combined bedplate and crank case unit, and the way the main bearing journals are carried. To facili-

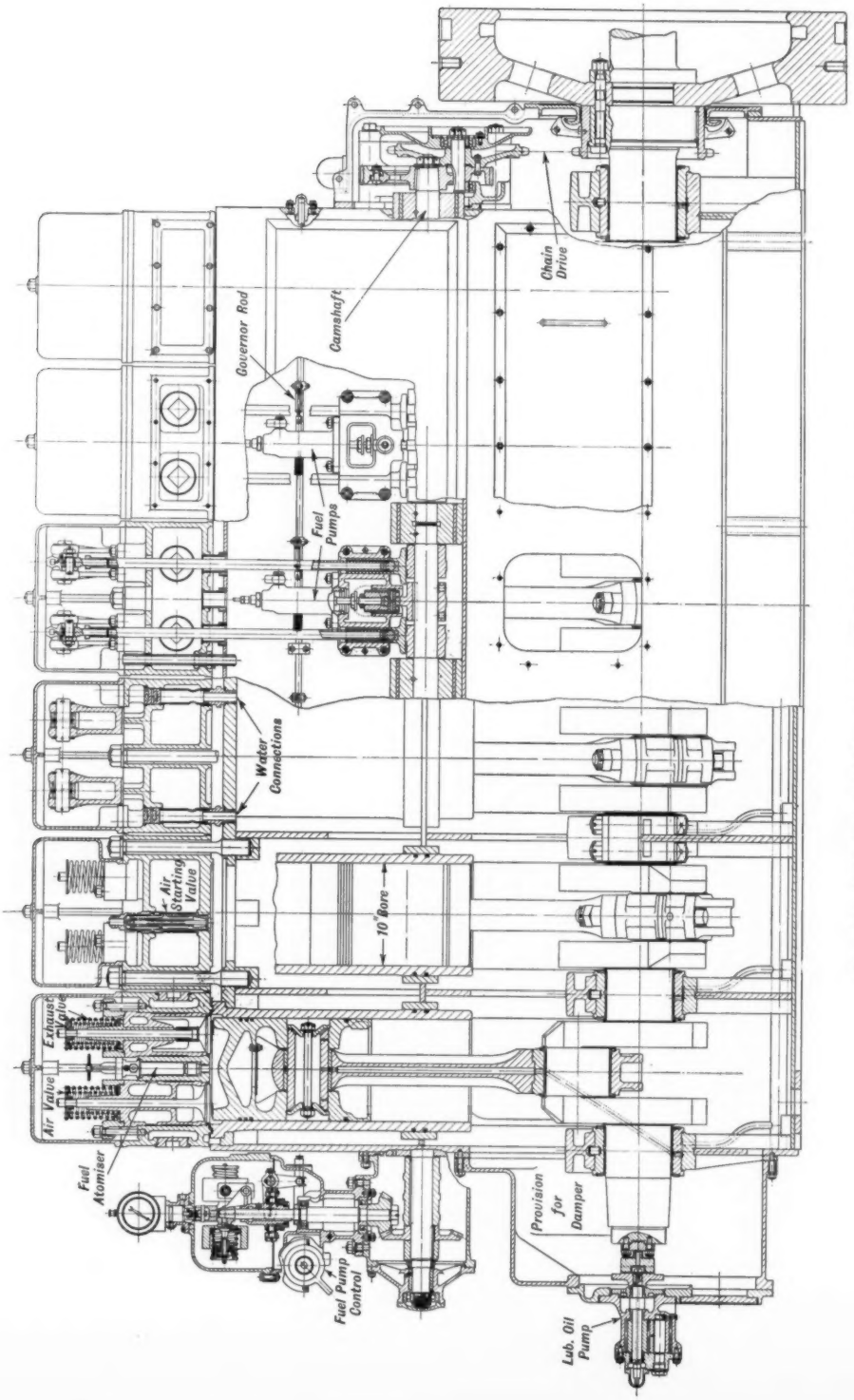


Fig. 2(a)—Longitudinal Section of 300 B.H.P. Oil Engine, Type K.

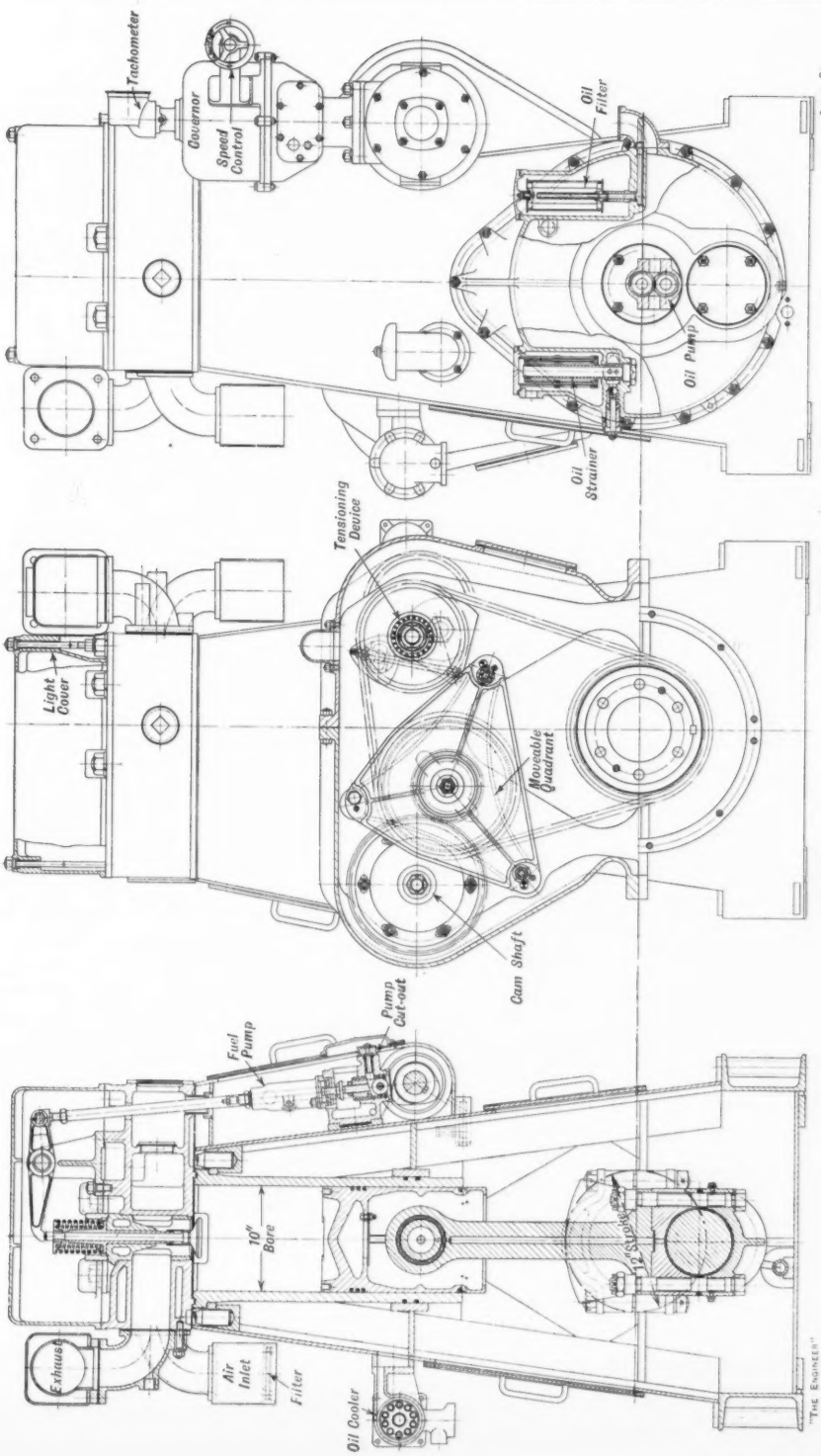


Fig. 2(b).—Cross Sections and other Details of 300 B.H.P. Oil Engine, Type K.

tate accurate erection, the assembled unit is machined after all welding operations have been carried out, datum pads, a pair on each longitudinal side and a pair at either end, providing for alignment in the longitudinal and transverse directions respectively. The design is such that by taking off the cylinder covers and withdrawing the pistons with their connecting-rods, the crank shaft can be removed through either end of the crank case.

The crank shaft is forged from the highest grade of bloom in one piece, and carries a solid flange for the fly-wheel, and a tapered and screwed portion at the opposite end, for the attachment of a damping device, should operating conditions call for the fitting of such equipment, in order to meet critical speed conditions other than those in the engine itself, which, it is claimed, is free from critical speeds and harmful torsional vibrations. The main bearing shells are made of steel with white-metal lining. Stampings of 35 tons Siemens-Martin steel are employed for the connecting-rods, which also have white-metal-lined bottom ends. A feature of the bottom end design is the provision of two small bolts at opposite corners, which are used to fasten together the upper and lower shells, and make them one unit, even after the bottom end bolts have been withdrawn for dismantling or during erection. The top end bearing is of phosphor-bronze.

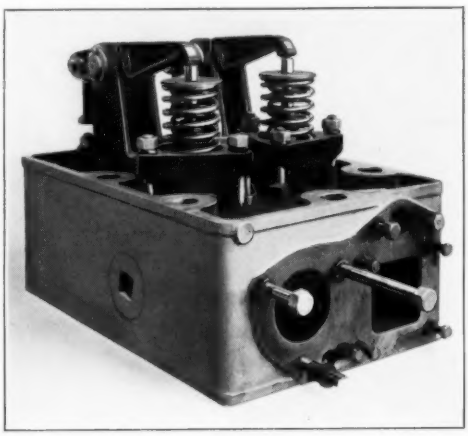


Fig. 4—Cylinder Head with Cover removed.

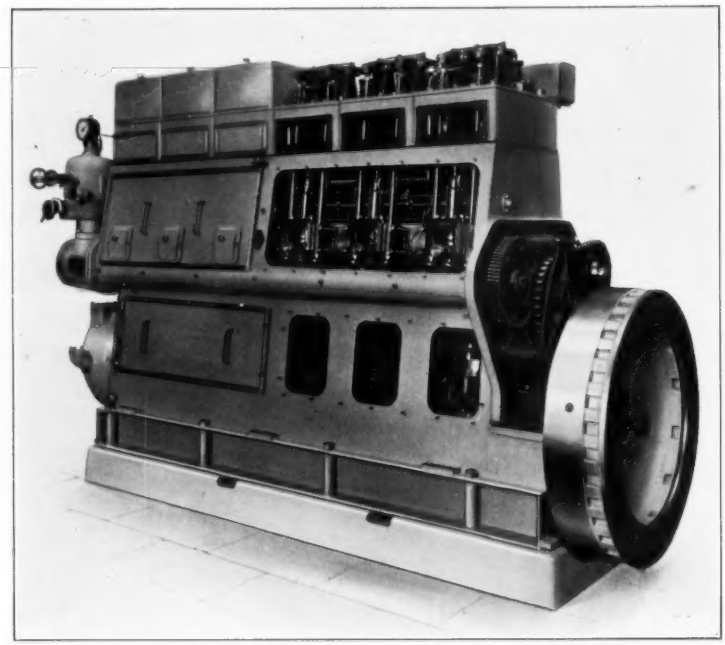


Fig. 3—General View of 300 B.H.P. 6-Cylinder Engine, Type K, with various Covers removed.

The cylinder liners are made of special cast iron mixture, the bores being finished by honing. Allowance is made for the expansion and contraction of the liners by fixing them at the upper end only, the water joint at the lower end of the liner being made by two oil and heat-resisting rubber rings.

The pistons have deeply dished crowns, and are made of special heat-resisting iron. A floating gudgeon pin is used and provision is made for its lubrication over the whole length of the pin.

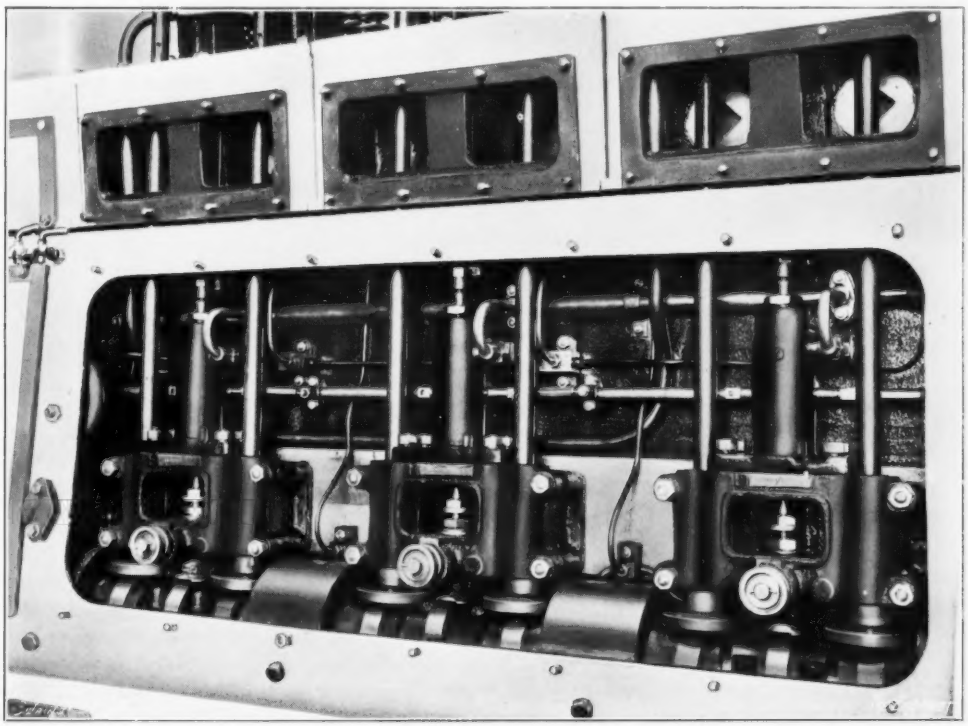


Fig. 5—Cam Shaft and Fuel Pump Assembly.

The pistons are designed with a special system of graduated clearances, which experience has shown gives the maximum transference of heat with minimum friction. There are three pressure rings, and one scraper ring below the gudgeon pin, the top ring being placed at a distance of a quarter of the cylinder bore down from top edge of piston in order to allow efficient lubrication and freedom from sticking.

Cylinder Covers and Valve Gear.

As will be seen from the drawings and from Fig. 4, a square design of cylinder head has been chosen. It carries the machined seatings for the air inlet and exhaust valves, and also the fuel atomiser or injector, and the air starting valves on such cylinders as are used for starting. The cover castings are of special heat-resisting cast iron, and particular care has been taken in their design to secure absence of vapour pockets by giving unobstructed circulation of cooling water. The water connections to the liner spaces are made with internal tubes. Removable plugs for cleaning are provided.

The whole of the valve gear is enclosed by a light removable cover, which gives access to the fuel piping, fuel injector, and rocker gear. Each valve has a separate cage, and the air and exhaust valves have long guides, and are operated by push-rods through rocker gear carried on the top of the cover, which is so arranged that it can be removed complete with the valves. The exhaust valves are made of specially high-grade heat-resisting steel. The top ends of the valves are hardened, as are also the tappet ends of the valve rockers. Two springs are provided on each valve in order to reduce to a minimum the risk of valve failure.

Both the fuel injection and starting air valves are automatic in action, and are opened by the pressure of the fuel and starting air respectively.

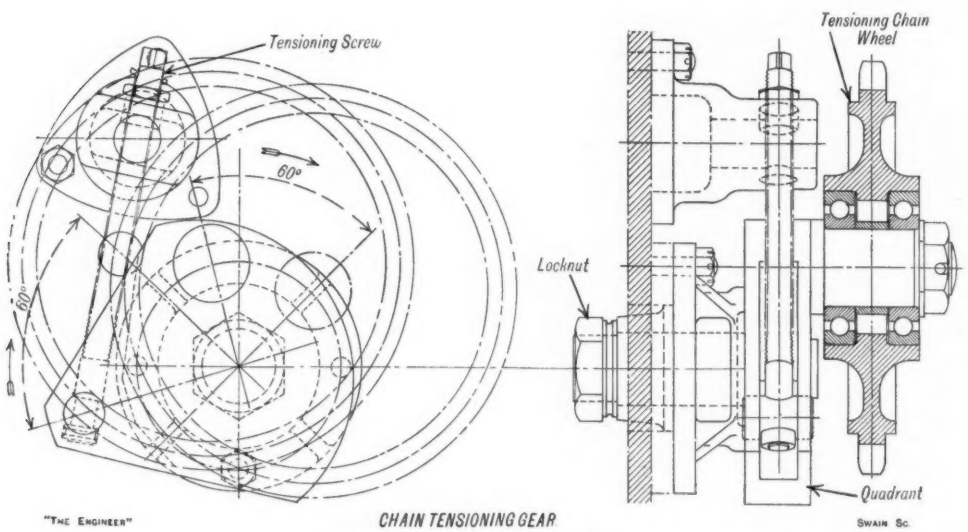


Fig. 6—Chain Tensioning Gear.

The arrangement of the cam shaft and fuel pump units with the through-going push rods is shown in Fig. 5. The cam shaft is housed in a compartment formed in the side of the crank case, with a bearing between each set of cams. The bearings take the form of bronze bushed steel sleeves, which are so dimensioned that the complete cam shaft can be withdrawn through them. All the cams are of steel, and are case-hardened on the working face, while the fuel cams are removable without disturbing the cam shaft. The tips of the cams dip into an oil bath.

The cam shaft is driven from the crank shaft by means of a vertical chain drive and spur wheel reducing gear. The gearing is clearly shown in the view of the engine from the flywheel end, with the gear cover removed. Fig. 3.

An interesting mechanical device is the chain tensioning gear, illustrated in Fig. 6. This arrangement consists essentially of a quadrant or throw plate, which pivots on a support attached to the crank case and carries the pin on which the chain tensioning wheel mounted on ball bearings revolves. In order to alter the tension of the chain, adjustment is made by a screw, one end of which freely revolves in a pin in the quadrant, while the threaded portion passes through another pin in a fulcrum bracket attached to the crank case, the screw being locked in position by a nut. The quadrant is tightened up to the crank case by the outer lock nut shown, after the chain tension has been adjusted.

The fuel injection equipment is of the Bosch standard pattern, each cylinder having its own pump unit. The fuel is supplied from an overhead strainer through a filter to the common main serving the pumps. Regulation of the amount of fuel delivered to the injectors for atomisation in the cylinders is effected by the horizontal movement of the governor rod or control shaft, which runs along inside the cam shaft compartment and is directly connected to the racks, which turn the fuel pump plunger and thus determine the quantity of fuel delivered per stroke. Each fuel pump is provided with means for individual adjustment so that the correct distribution of the load over all the cylinders can be accurately maintained. There is also a cut-out device, on each pump unit, which, when turned, puts the pump out of action by holding-up the operating plunger clear of the fuel cam.

The governor is of the centrifugal type, the design adopted having been used for a number of years in various sizes of steam turbines and oil

engines manufactured by the English Electric Company, Ltd. It is driven from the cam shaft through bevel gears, and the speed of the engine can readily be altered by varying the load on the tension spring provided for the purpose. At the side of the governor is a conveniently arranged fuel pump control gear, and above the governor a tachometer gives the speed at which the engine is running.

Lubricating and Water Circulating Systems.

The supply of lubricating oil is maintained by a gear-type pump driven from the crank shaft. It lifts the oil from the sump tank and delivers it through a fine mesh strainer and an oil cooler attached to the side of the engine, thence to a bus pipe inside the crank case with connections to the crank shaft main bearings. The crank shaft is drilled to supply oil to the connecting-rod lower end bearings, from which it is led up through the connecting-rods to the small end bearings and floating piston pins. The pistons are lubricated by oil thrown from the bearings of the crank shaft, but the valve gear, cam shaft bearings, and all other points are supplied with oil from the forced lubrication system.

In order to maintain the oil in clean condition, a small portion of it is by-passed from the pressure system after the strainer, through an oil filter of felt, back to the sump tank.

The jacket cooling water flows through a pipe of large section, which runs the whole length of the engine, within which the oil cooler is arranged, this main having a separate connection to each cylinder. From the cylinder liner jackets the water flows to the cylinder heads through two connections with a separate outlet from each cover to the water jacket of the exhaust manifold. The drawings and engravings indicate the neat arrangement of the welded exhaust and air inlet manifolds. The air inlet manifold is common to all cylinders, with separate connections to each cylinder, and is arranged below the cylinder covers at the back of the engine. It has openings on the underside which are covered with gauze and cocoanut fibre matting so forming an effective air filter.

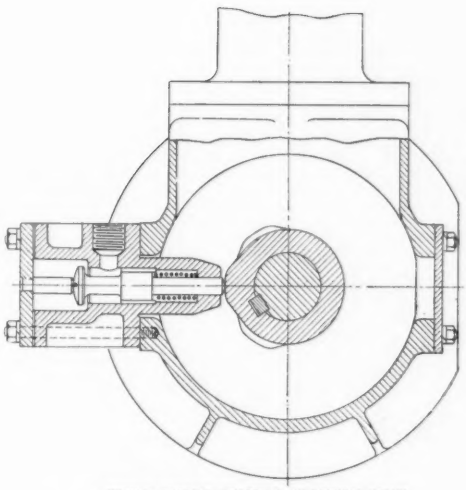


Fig. 7—Starting Air Valve.

Air Starting Arrangements.

The starting air receiver is connected through a master valve to air-distributing valves automatically brought into action when the starting air valve is opened. One of these valves is illustrated in Fig. 7. In the cylinder heads are automatic valves for admitting the starting air to the cylinders. These valves, which are spring-loaded, open when the pressure in the cylinders is less than the starting air pressure and return to their seats when the air is cut off by the action of the controlling valves.

The master control valve may be arranged either on the starting air receiver or at a convenient point near the engine running controls.

Performance and Oil Consumption.

The full-load "Farnboro" indicator diagram and the pressure volume diagram derived from it, which we reproduce herewith, Fig. 8, clearly show the smooth character of the combustion cycle, and the moderate maximum pressure attained. The engine was tested under all load conditions with, we learn, very satisfactory results.

In accordance with its practice in the past, the guaranteed fuel consumptions of the English

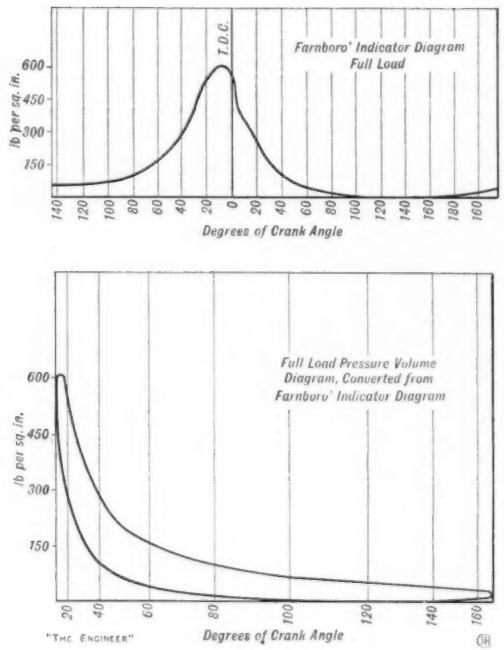


Fig. 8—Indicator Diagrams.

Electric Company, given below, are those which the purchaser of an engine can count on obtaining under ordinary working conditions, providing the engine is properly looked after. The figures applying to the series of engines we have described are 0.39 lb., 0.41 lb., and 0.44 lb. per B.H.P.-hour at full, three-quarter, and half-load respectively, using the ordinary Diesel fuel oil supplied in this country, which has a net calorific value of about 18,500 B.Th.U. per pound.

The consumption of new lubricating oil for the 300 B.H.P. engine, given on the same dependable basis as the fuel figures, is 1.2 pints per hour.

The English Electric Company occupies a unique position as it is the only one in this country which manufactures not only the prime mover, but also a large range of Electric Generators, Switchgear, Motors, Control Gear, and other electrical machinery and apparatus necessary for the equipment of a Power Station or the electric driving of Industrial Works.

It will be appreciated that the ability of the Company to design, manufacture and test in their own works the several items for a comprehensive contract, and to take undivided responsibility is a feature of great value in the smooth and efficient carrying out of a contract. Delivery and assembly on site is also thereby facilitated.

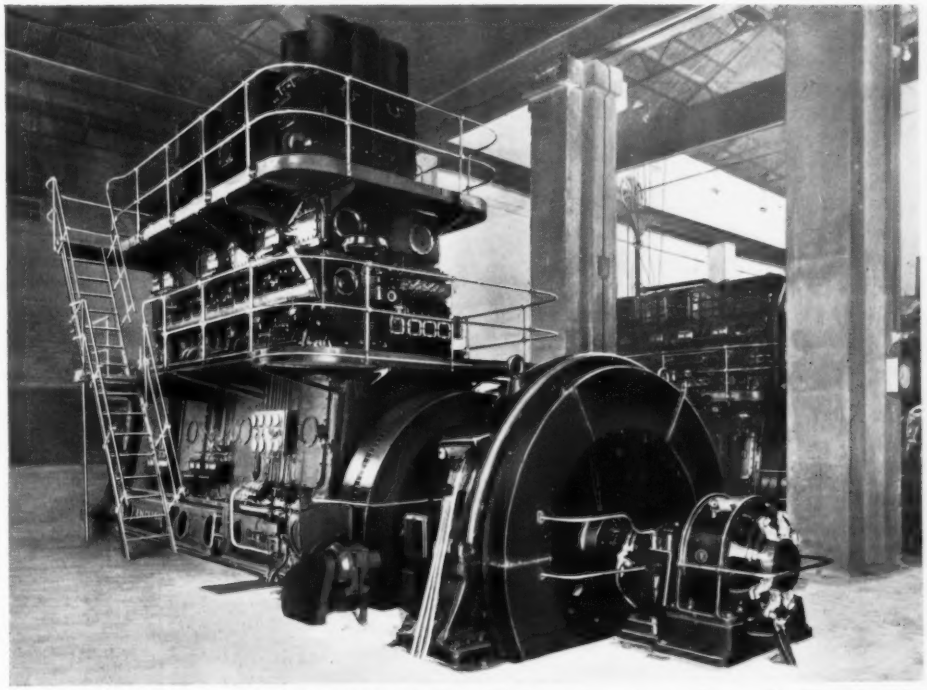
The present range of Diesel engines manufactured by the English Electric Company, Ltd., is as follows :—

RANGE OF ENGINES.

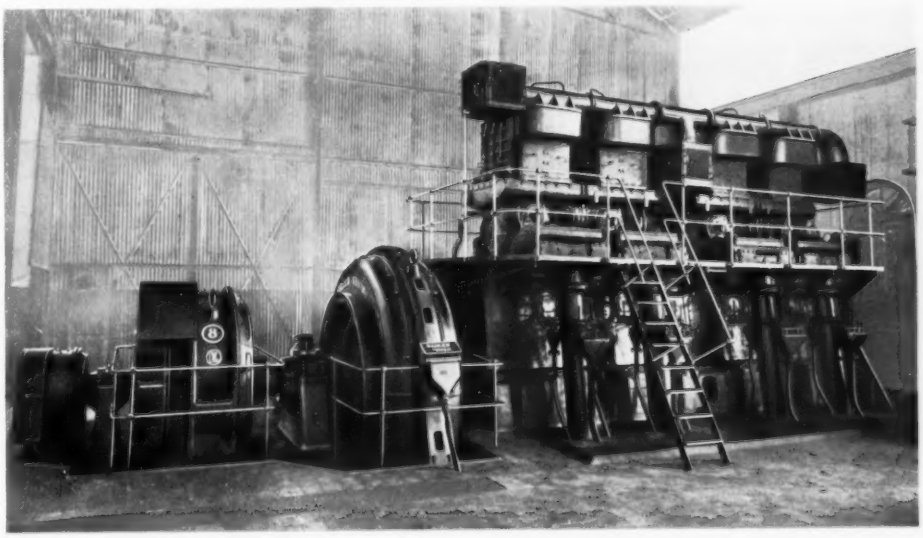
Size.	No. of Cranks.	R.P.M.	B.H.P.	Generator (kW).
		"K" TYPE.		
3K	3	600	150	100
4K	4	600	200	135
5K	5	600	250	165
6K	6	600	300	200
7K	7	600	350	235
8K	8	600	400	270
		"L" TYPE.		
3L	3	375	375	260
4L	4	375	500	345
5L	5	375	625	430
6L	6	375	750	520
7L	7	375	875	605
8L	8	375	1,000	690
		FULLAGAR ENGINES.		
4Q	4	300	980	670
6Q	6	300	1,470	1,000
8Q	8	300	1,960	1,340
6R	6	214	2,620	1,800
8R	8	214	3,500	2,400

Forty Fullagar engines are now in successful operation with an average of over 1,000 h.p. each.

Two Recent Fullagar Engines.



Six-Crank Engine, 2,500 B.H.P., 200 R.P.M., driving Alternator. Bermuda Electric Light, Power & Traction Co.



Four-Crank Engine, 1,500 B.H.P., 250 R.P.M., driving tandem D.C. Generator and 3-phase Alternator. Karachi Electric Supply Co.

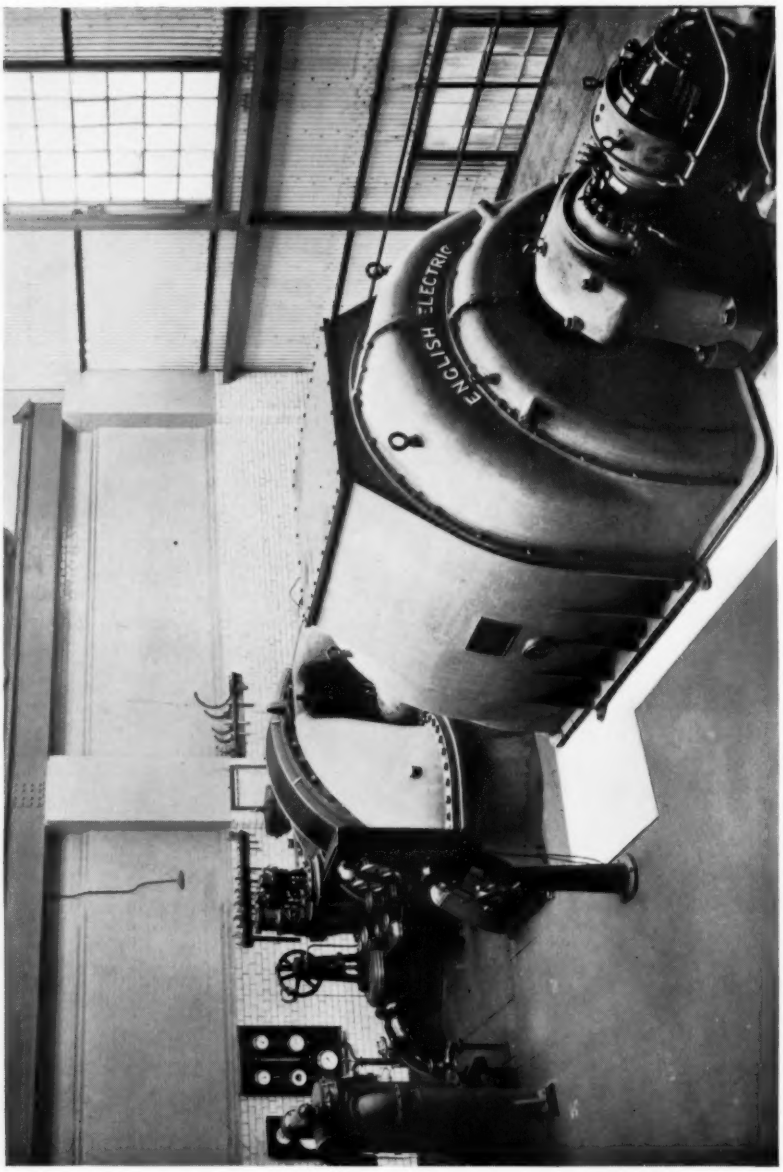


Fig. 1. 7,500 kW, 3,000 r.p.m., Single Cylinder Turbo-Alternator Set in the New Power Station of Slough Estates Limited.

Slough Estates Limited.

Extension of Power Station.

The inauguration of these extensions and formal starting up of the new generating plant by Mr. A. Noel Mobbs, O.B.E., Chairman of Slough Estates Limited, was the occasion of an interesting ceremony on February 14th.

This undertaking has so many interesting features that a description of the new power station plant may well be prefaced by a brief outline of its history and development.

The Slough Trading Estate was originally laid out during the War as a repair depot for the whole of the Mechanical Transport of the Expeditionary and Home Forces. The scheme included an electric generating station, gas works, water supply and railway services.

The whole property was purchased soon after the end of the War by the Slough Trading Co., Ltd., whose successors, Slough Estates, Ltd., at once commenced to develop the estate as a model factory area.

The total area of the estate is approximately 670 acres, of about which one-third has already been developed by the erection of modern factories, and on the eastern section, of good-class dwellings.

At the present moment some 144 tenants are operating factories producing almost every kind of commodity from confectionery to motor cars, and they take their supplies of gas, water and electricity (and, in some cases steam) from Slough Estates, Ltd., whose Engineering Department is under the control of Mr. S. Harper-Bill, B.Sc. (Eng.), as Chief Engineer. There is also a complete railway system on the estate, and practically every factory has a rail siding to its doors, and in some cases into the building. The traffic is handled by the Estate Company's locomotives for transfer to and from the main line of the Great Western Railway.

The development of the estate has naturally called for larger supplies from these services, and in each case careful consideration has been given to the best way of meeting the increasing demand. A few years ago it was decided to close down the Estate Gas Works, and an arrangement was entered into with the Slough Gas and Coke Co. for a bulk supply of gas for distribution by Slough Estates, Ltd., to their tenants, who have thereby obtained a very satisfactory service.

Previous to 1930 the water supply was taken directly from a well sunk through the lower green sand to a depth of 1,130 feet, which produced, according to an eminent firm of consulting water analysts, one of the purest waters in the country. In 1929 the demand on this well was approaching the limit to its capacity, and after careful investigation and enquiry, a report was submitted by the Chief Engineer recommending the construction of a reservoir rather than the sinking of another bore. This report having been confirmed by a

Mr. S. Harper-Bill, B.Sc. (Eng.), chief engineer to Slough Estates, Ltd.

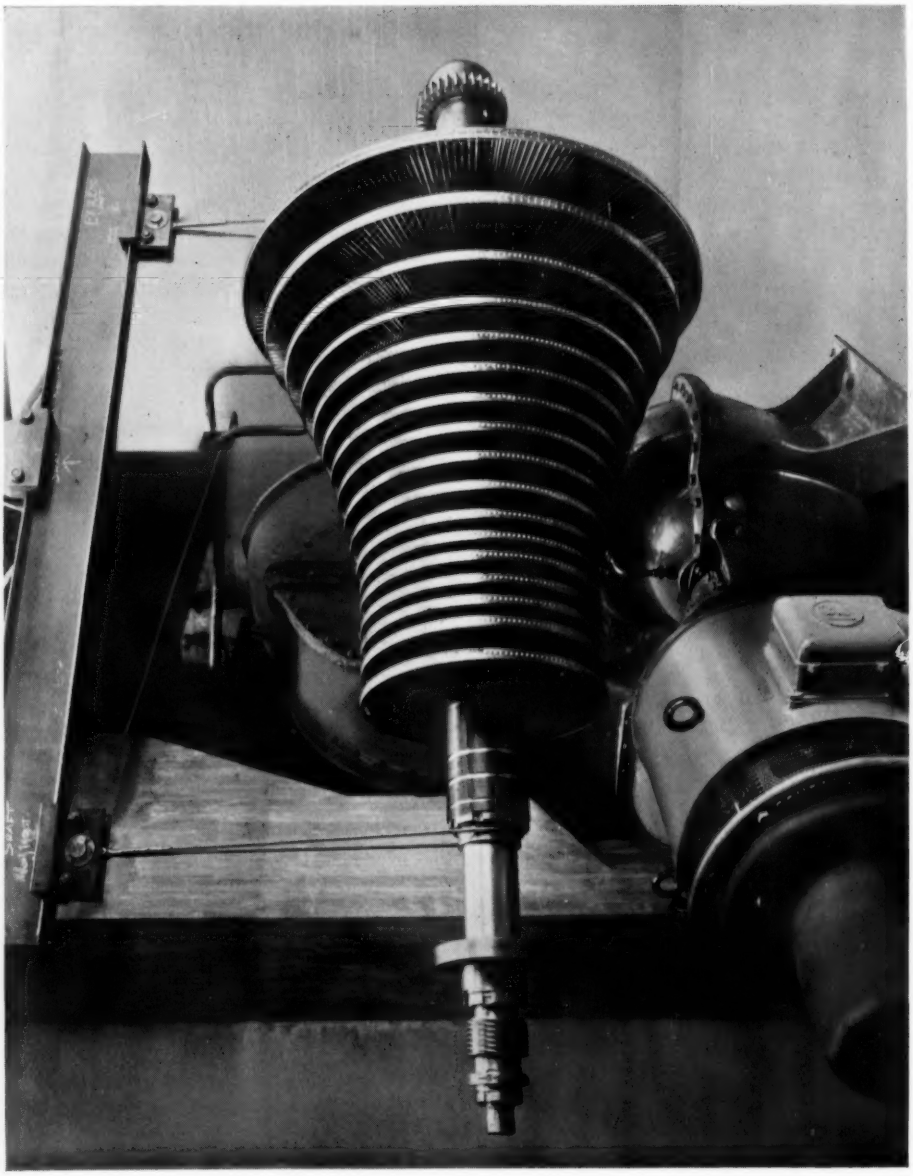


Fig. 2. The Rotor of the Single-cylinder Turbine

well-known consulting water engineer, the scheme was adopted, and a three million gallon storage reservoir was constructed near the north-western border of the estate, which has had the effect of doubling the available supply.

In the winter of 1929-30 the electrical load on the power station was approaching the full-load of the available plant, after allowing an adequate margin of stand-by capacity, and consideration was given as to whether it would be more economical to extend the plant or to purchase in bulk from the supply undertaking serving the district. After negotiations extending over about eight months the authorities concerned agreed that a bulk supply could not be given at a price comparable with that at which electricity could be generated in the estate power station, and that consequently there was no alternative to the continued operation of the power station and its extension as and when necessary.

In December, 1931, there was a record consumption of electricity on the estate, and it became essential to consider the capacity of the plant to deal with the expected load for the winter of 1932-3. Early the following year, therefore, the Chief Engineer was authorised to draw up plans and specifications and call for tenders in accordance with his earlier proposals; enquiries were issued to all the leading British and Continental manufacturers on February 20th, 1932. Tenders having been received and thoroughly analysed by the Chief Engineer, the Board decided early in April, 1932, to consult Messrs. Preece Cardew and Rider as to whether the proposed scheme was a suitable one in all the circumstances, and in due course the consultants expressed their agreement with the scheme as drawn up and the tender recommended by the Chief Engineer.

On April 8th (or fifteen days after receipt of tenders) the Chief Engineer was authorised to place an order with the English Electric Company, Limited, for a 7,500 kw. 6,600-volt turbo-generator set, with all auxiliaries, switchgear and cooling tower, and the order was accepted for delivery and completion in 7½ months.

At this time the boiler-house contained four Babcock and Wilcox boilers with chain grate stokers, having a total capacity of 120,000 lbs. of steam per hour, coal and ash handling plant, economisers and super-heaters. The turbine room was equipped with one Ljungstrom and two Parson's turbo-generators of 1,000 kw. each and one Oerlikon turbine generator of 3,000 kw., the whole plant operating at 440-volts and having an overload capacity of 25 per cent. for two hours. It will be seen that the new set doubles the capacity of the station.

The new plant as laid out and specified by Mr. Harper-Bill is of the most modern design throughout, and designed for the utmost economy in running. The comprehensive contract awarded to the English Electric Company included a concrete cooling tower, Fig. 4, which is a landmark for the district, and is believed to be the first of its type to be erected in this country for industrial purposes.

The turbine room has been extended by two bays each 20 ft. long in order to provide space for the generating set that has just been installed, and the basement floor level over this new area has been lowered by 2 ft. The new set consists of a single-cylinder impulse turbine running at 3,000 r.p.m. and driving a 6,600-volt 3-phase 50-cycle alternator having a maximum continuous rating of 7,500 kw. at a power factor of 0.8. Views of the completed unit and of the rotor are shown in Figs. 1 and 2, whilst Fig. 3 illustrates the lower half of the turbine casing. The turbine with its condensing plant, and the air cooler for the alternator, were manufactured at the Rugby Works of the English Electric Company, whilst the alternator and its switchgear were produced at their Stafford works.

The steam turbine is of the most modern high-efficiency construction designed to operate with a steam pressure of 200 lbs. per square inch gauge, superheated to 580 degs. F. and to exhaust into a surface condenser, maintaining a vacuum of 28 inches Hg. when the set is on full load. Steam is admitted to the turbine through a main throttle valve and auxiliary valves under the control of a sensitive centrifugal governor. Provision is made for automatic closing of the main stop valve and the main throttle valve in the event of the speed rising above a predeter-

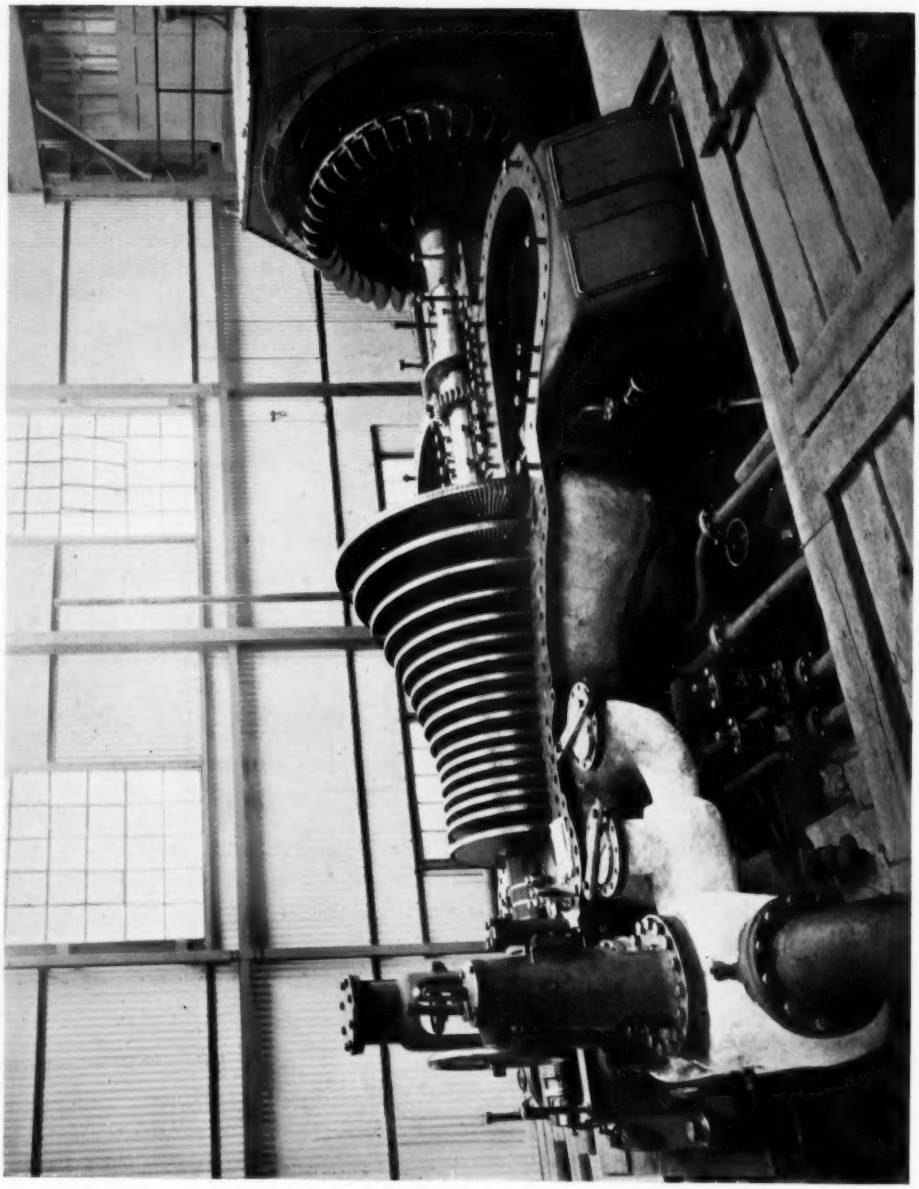


Fig. 3. The lower half of the Turbine casing, with the rotor in position.

mined limit, and the set can be shut down at any time by pressing a trip knob which brings this automatic gear into operation. The various steam valves are operated by a system of oil relays fed from the main oil pressure system, and, therefore, the governor has only to exert the comparatively small forces required to move the pilot valves of the relays.

The nozzle passages are formed in diaphragms secured to the outer casing, the casing and diaphragms being split on the horizontal diameter to facilitate erection. The diaphragms at the high-pressure end of the machine are of the built-up type in which accurately machined nozzle segments are securely mounted on a mild steel centre; the remaining diaphragms are of special quality cast iron, and the nozzle passages are formed by nickel-steel plates cast into the rim of each diaphragm. This design affords the best means of producing nozzle passages of the correct shape and finish that is an important factor in securing the highest efficiency.

The discs supporting the first seven rings of blades on the rotor are machined out of a single high-grade steel forging which is also turned to form the shaft of the turbine. The discs for the remaining stages of the rotor blading are machined from separate steel forgings, and are pressed on and keyed to the shaft. The rotor blading is made from solid bar of 3 to 5 per cent. nickel steel, each blade being machined all over and formed in such a way as to incorporate the necessary distance piece, and the "T" root by which it is secured to the rotor disc.

The turbine casing is anchored to the foundations at the exhaust end, but the support at the steam end is free to slide on a suitable key, thus allowing the turbine body to move in an axial direction under the changes of temperature.

Other interesting details of the turbine are the thrust block of the well-known Michell type, which is combined with the bearing at the high-pressure end, and the flexible coupling at the exhaust end by which the turbine is connected to the rotating portion of the alternating-current generator. An ample and efficient lubricating system is provided for supplying oil under pressure

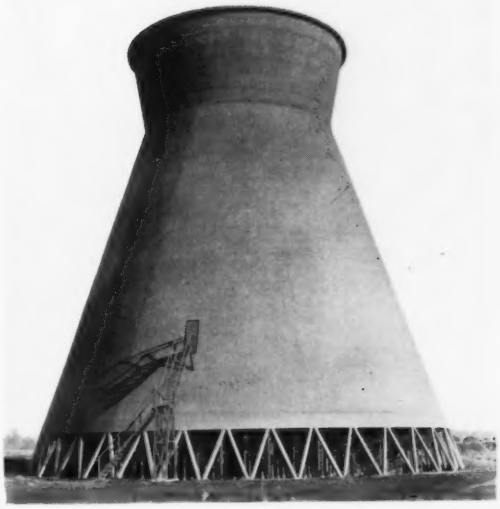


Fig. 4.—The Ferro-concrete cooling tower, capable of cooling 730,000 gallons of water per hour from 92.5°F. to 80°F.

to all working parts, including the bearings, the coupling and the main governor gear. Oil is drawn from a tank situated below the steam end pedestal by means of a gear driven pump and passes in its circuit through an oil cooler of the tubular type. For use when starting up and shutting down the turbine, and in case of emergency, an auxiliary oil pump driven by a small vertical steam turbine is built into the unit.

The turbine exhausts into an "English Electric" surface condenser designed for a vacuum of 28 inches Hg. when supplied with cooling water at 80 degs. F. The distinctive feature of the condenser is the arrangement of the tubes in such a way as to ensure the most efficient distribution of the steam over the whole condenser surface, while offering the minimum resistance to the passage of the steam. The circulating passages are free from sudden changes of area, and the design is such as to facilitate the release of air. The auxiliary equipment for the condenser plant includes a two-stage steam ejector for air extraction and a two-stage centrifugal pump for the condensate.

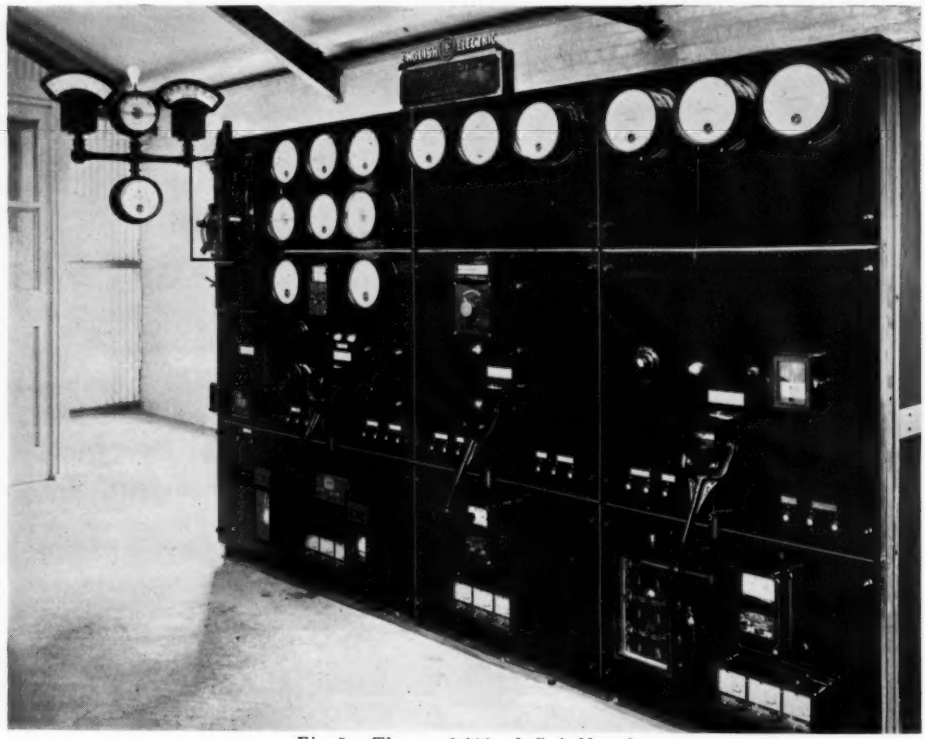


Fig. 5.—The new 6,600 volt Switchboard.

The direct-coupled alternator is of the " English Electric " standard totally-enclosed design with a small direct-current generator for the field excitation, mounted at the end remote from the turbine. The alternator is cooled on the closed air-circuit principle, the heated air passing through an air cooler and then circulating again through the cores and windings of the machine. The rotor which carries the excitation winding together with the shaft ends is formed from one solid forging of special high-quality steel.

The ferro-concrete cooling tower, for which Messrs. Film Cooling Towers, Ltd., were the sub-contractors, is capable of cooling 753,000 gallons of water per hour from 92.5 deg. F. to 80 deg. F. when working at an atmospheric temperature of 55 deg. F., and a relative humidity of 75 per cent. This structure, which is illustrated in Fig. 4, is 104 ft. 4 ins. in diameter at the base and 100 ft. high. The circulating water piping connecting the tower to the condenser is of mild steel with sleeve joints electrically welded from the outside. This welding was carried out by a tenant firm on the estate, Messrs. Electric Welders (Slough), Ltd., who also undertook the removal of the air filter of one of the existing generating sets. The packing used for the condenser tubes was supplied by another manufacturer whose works are on the estate, namely, Messrs. Crane Packing, Ltd.

Reliability and economy have been studied in every detail of the new plant, and the English Electric Company have embodied suitable equipment for heating the " make-up " feed-water to the boilers.

The adoption of 6,600-volts as the generating pressure of the new set necessitated considerable modification of the existing switchgear for the 440-volt plant, in addition to the installation of new 6,600-volt gear. Hitherto all the power was generated at 440-volts and a part was stepped up to 6,600-volts. In order to utilise the existing

equipment as far as possible, and as a first step to changing the voltage to the higher figure, arrangements have been made for synchronising from either the 440-volt side or the 6,600-volt side as may be required. The new 6,600-volt switchboard is of the English Electric Company's remote mechanically-operated steel cubicle type. The cubicles are mounted on the turbine basement level and the control panels in line with the existing 440-volt panels on the switchboard gallery above. This board contains one alternator panel, one voltage regulation panel, a 2,200 kVA. feeder panel and synchronising gear.

Additions to the 440-volt equipment consisted of flat back panels to match the existing panels, containing apparatus for remote control of the auxiliaries of the new turbo-alternator set and for controlling the low-tension side of a 1,875 kVA. transformer.

The rearrangement of the switchgear had to be carried out in accordance with a careful programme in order to avoid any prolonged interruption to the running of the plant. Some of the existing 440-volt gear had to be removed, new panels added and the connections on the high-tension and low-tension sides of the 1,875 kVA. transformer changed over to the new control gear. The work of installing new cables required in connection with this work also formed part of the main contract, and was carried out for the English Electric Company by Messrs. Edmundson's Electricity Corporation.

Shipment of Large Armature to South Africa.

In the last issue of this journal illustrations and details were given of the 18,000 (peak) H.P. Reversing Mill Motor for the new steel works of the South African Iron and Steel Industrial Corporation. The armature of this motor was despatched from the Stafford Works of the Company on Sunday, January 15th last. Special arrangements were necessary for the transit by the London, Midland and Scottish Railway Co. to Birkenhead. The armature weighed 61½-tons gross and when loaded on to an 80-ton well trolley reached 13′-4″ above the track level. The diameter was almost 11′-0″ and a strict condition for the whole journey was that the load should not pass any passenger traffic or out-of-gauge loads, and special working was observed throughout the whole journey. The special train left Stafford at 6.52 a.m. and arrived at Birkenhead by noon of the same day, and the armature was immediately shipped on

board the S.S. "Clan Urquhart." Our illustration shows the unloading of the armature at West Float, Birkenhead

The British Industries Fair.

Some details of an Interesting Exhibit.

THE two stands of the English Electric Company at the British Industries Fair, Castle Bromwich, Birmingham, showed a particularly representative selection of the company's products. The main stand, which measured 45 ft. × 20 ft., was devoted to electrical machinery, equipment and apparatus, and a smaller stand, 40 ft. × 6 ft., was devoted to the Company's domestic products. The former stand, being an island site, was admirable for an effective display of the Company's larger products. The general design of the stands, as seen in the frontispiece of this issue, was of a pleasing appearance, and was carried out in a blue, buff and black colour scheme which enhanced the general simplicity of the whole scheme. An effective arrangement of concealed lighting not only supplied the necessary illumination but added considerably to the general effect of the stands.

Altogether nearly 50 various types of apparatus or models were displayed, and these largely covered the products of the Stafford, Rugby and Bradford Works of the company. Products of the Preston Works were represented by a series of framed photographs showing :— a recent example of a luxurious body specially designed and executed for long distance journeys by motor-coach from the Lancashire coast to London ; an "A.E.C.—English Electric" double deck trolley bus for the London United Tramways ; a modern double deck tramcar for the London County Council, having a seating capacity of 70 passengers ; whilst railway traction was illustrated by a 2,400 volt Freight Locomotive for the Harbour Commissioners of Montreal, capable of hauling a load of 100 tons ; and a battery locomotive for industrial purposes propelled by two 23 H.P. motors operating at 200 volts.

A Traction Department exhibit, which is of particular interest at the present time, was a traction motor of 160 horse-power D.C. for the Danish State Railway. The Contract comprises the complete electrical equipment for 42 motor-coaches and 21 trailer coaches. It is of more than passing interest to record here that the first main portions of the electrical equipment were shipped from Hull on Friday, March 10th.

Amongst the exhibits on the stand were standard industrial motors of various types for alternating current or direct current systems, and motors for special applications such as crane service and traction service ; there was also included a flameproof motor for mining service, and an external fan ventilated motor of the "Closvent" type which has been specially developed for dusty situations. Other interesting examples from the company's range of products were a high-torque single-phase capacitor motor ; a small polishing motor mounted on a pedestal which also incorporated a push button contactor starter ; a squirrel-cage totally-enclosed motor mounted on a spring suspension base, suitable for the individual driving of textile looms ; a stator and rotor shaftless unit for building into machine tools. Some of these exhibits form the subject of a special article in this issue (see page 112). Fractional horse-power single-phase motors were also exhibited suitable for driving oil separators, washing machines, small printing machines, sewing machines, and other similar industrial and household machines.

CONTROL GEAR.

Various types of control gear were shown for industrial and mining service. They included air-break and oil-immersed hand operated starters for the control of squirrel-cage and slipring motors of various sizes up to 50 H.P. ; a push button operated contactor starter for squirrel-cage motors ; a flameproof air-break drum controller for mining service, and simple push buttons for the remote control of electrical machines.

Another interesting exhibit was the flameproof air-break drum controller of new design, having a maximum rating of 60 H.P.

The principal features of the design are simplicity of action and easy accessibility, combined with reliability. The whole of the drum can be withdrawn by simply removing the bolts in the top cover. All adjusting points on the contact fingers are so arranged as to be accessible from the front of the controller. A new type of air-break starter for squirrel cage motors was on view. This is ironclad, totally-enclosed and dust proof. It is suitable for wall or floor mounting, and provided with a hinged cover. It has thermal overload releases, a drum type switch with two breaks per phase. and cannot be. operated incorrectly. The switch assembly is self-contained, and can easily be removed. The internal arrangement of the starter gives complete accessibility to all parts and provision is made for complete and easily adaptable cable arrangements.

Arc Welding.

The company's latest contribution to the rapidly increasing use of arc welding was represented by a self-contained 200 ampere D.C. arc welding equipment. This comprises a motor-generator with full control gear mounted as a complete unit. It is generally recognised that to provide each welder with a separate generator is the most economic, efficient and serviceable method of providing current for arc welding. This type of equipment is simpler in construction, cheaper, and more efficient in operation, and far more easily adapted to workshop conditions than an alternative arrangement of supplying several arcs from one generator.

A similar type of equipment, for supplying two operators, comprises two generators, each coupled at the end of a suitable motor and mounted on one bedplate. The control gear can be supplied mounted on the same bedplate, or alternatively, in a separate cubicle. For convenience of transporting the equipment to various places in a factory the Company can provide arc welding sets mounted on a strong wheelbase with a swivelling head to facilitate steering.

Larger Plant and Machines.

The larger type of products of the company were represented by a Mercury Arc Rectifier for the conversion of alternating current to direct current. This exhibit was of considerable interest as one of the most recent examples of a non-rotating conversion unit. The rectifier shown had an output of 1,000 amperes, 500/1,000 volts, 500/1,000 kilowatts. Our readers will remember that the mercury arc rectifier formed the subject of an article in the last issue of this journal.

High Voltage Generation.

A 15,000 volt D.C. Generator, part of a model dust precipitation or electro detarring equipment made by the Whessoe Foundry and Engineering Co., Ltd., was also on view. The generator and this apparatus form an important contribution to the solving of the problem of electrostatic precipitation of fog and dust from industrial gases. This plant also was fully described in our last issue.

Transformers.

The transformers manufactured by the Company range from small instrument transformers to the largest units operating on the 132,000 volt systems of the "Grid."

One of the most interesting transformers on exhibit was a new design of 5 kVA. Combined Flameproof Transformer and Switch Unit. It is mounted on skids, and has been specially designed for coal face lighting, haulage room lighting, or for use with small power drills. The transformer is of the double wound semi-core type with the mid-point of the secondary brought out to a separate linked terminal for earthing, the link is provided for testing purposes. The high tension switch is of the oil immersed flameproof type, and has overload trips; the low tension switch is of the air-break type, is fitted with fuses, and enclosed in a frameproof case.

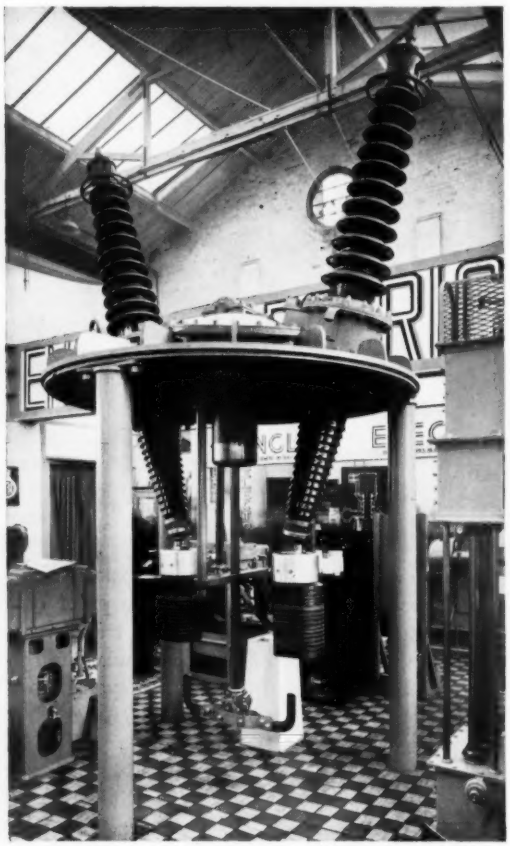
A 25 kVA. outdoor distribution transformer, with tapping switch, of a type standardised for pole mounting in rural distribution systems, was also shown.

Induction Regulators, for the automatic regulation of the voltage of alternating current systems, were represented by a complete Regulator and various component parts of a similar unit. This Regulator was suitable for maintaining constant voltage, within plus or minus 10 per cent. of the mean value, on a 3-phase system at

400 volts. The Company is the largest manufacturer of this type of apparatus in this country.

Switchgear.

Amongst the recent developments in this branch of the company's activities was a single-phase 132,000 volt circuit breaker with de-ion grid contacts. This was of the outdoor type, solenoid operated, and had a rupturing capacity of 1,500,000 kVA. This was similar to apparatus installed in a large number of substations of the Central Electricity Board for the control of their main " grid " system. A further product demonstrating apparatus for the control of large power circuits was a metal-clad switch unit for 11,000 volts with a rupturing capacity of 150,000 kVA. This was also equipped with de-ion grid contacts.



Single-phase Circuit Breaker. Size OKD. 5, fitted with de-ion contacts. Outdoor type. Solenoid operated. Rupturing capacity 1,500,000 volts.

The company has devoted considerable attention to the design and production of flameproof switchgear for use in mines. Their designs have been approved by the Mines Department, and embody every essential feature for mining duty. Simplicity in connecting up and maintenance has been carefully considered, and the example on exhibition was fully representative of the company's appreciation of the responsible part played by electricity in the cheap production of coal. A model to illustrate the construction of a circuit breaker contact system with special de-ion contacts, similar to those on the 132,000 volt circuit breaker was also on view. Other recent developments exhibited were the company's latest design of sensitive trip handle with a special large scale demonstration model of the same, and a thermal oil trip breaker suitable for 12,000 volts, 100 amperes.

High Rupturing Capacity Fuse Gear.

It is of more than passing interest here to state that the Fuse Gear products of the English Electric Company are designed and manufactured under strict laboratory control in a self-contained factory devoted entirely to the manufacture of Fuse Gear. As a result the Company has been able to develop and perfect a range of fuse gear of a particularly high standard. Amongst the exhibits of this section were a weatherproof low tension fuse distribution board which complies fully with Home Office requirements, and has rapid cabling features of particularly original design. The direction of the cable socket is reversible, and gives top or bottom entry without looping, with always a direct run from the cable socket. The busbars are of round section about which the panels can be rotated, thus affording full access to the cable tails. The busbars are also completely shrouded by a detachable insulating shield. The incoming cable connector is easily and quickly adjustable to suit the length and position of the cable. A compound tight cable box for top, bottom or side entry, fitted with insulated cable spreader is provided. These boards have a guaranteed rupturing capacity of 25,000 kVA.

The Universal Fuse Unit shown, also of 25,000 kVA, has been specially designed for kiosks and sub-stations, it can be bolted direct to the wall as no space is required at the back of the board. The busbars are placed behind the units, and all connecting up can be carried out at the front for any desired circuit arrangement. There is ample space in the cable box for phasing-out tails. It incorporates the " English Electric " heavy duty non-deteriorating high rupturing capacity cartridge fuse. It is also suitable for medium duty with " English Electric " handle type, non-deteriorating rewireable fuses. These medium duty units are immediately interchangeable with heavy duty cartridge carrying handles when the transformer capacity increases. It is made in 5 sizes, 60 amperes to 800 amperes.

Typical sections of a skeleton type link and fuse unit for substation use were also shown. This type of fuse gear is easy to erect owing to the unit assembly on cross channel wall bearers ; all parts are fully accessible, and the unit can be extended as required without interference with existing live circuits. It is bolted direct to the wall as no space is required at the back of the unit, and, being entirely self-supporting, no foundation is necessary. The busbars and cable boxes are carried out on the main structure which is supplied complete in every detail ready for commissioning ; all forms of fixed or portable metering can be incorporated. Both sides of the fuse can be isolated. This type of unit, which has been approved by the Home Office Authority, is made in two sizes, 400 amps. and 800 amps., and can be equipped with fuses of any required rating.

DOMESTIC, HEATING AND COOKING APPLIANCES.

The Company's activities in the domestic field were represented by the display on the small stand which was devoted to electric fires and a full range of electric cookers suitable for large or small families. The capabilities of the cookers were shown by actual cooking demonstrations during each day of the Exhibition.

A complete range of the nine standard colours of the company's 1 K.W. and 2 K.W. Fires was also exhibited with examples of the Company's showcards and other advertising media.

The Electric Fires were dealt with in an article in the July issue, Volume VI., No. 2, and the cookers form the subject of the succeeding article.

" English Electric " Cookers.

The entry of the English Electric Company into manufacturing and marketing of domestic appliances was an obvious step. Realising the continually increasing application of electricity in the home and the facilities now made available by distribution authorities, it was evident that here was an outlet for a new activity.

The success which has attended the introduction of the " English Electric " Fire has been repeated in the Cookers now on the market. The Company has produced a range of cookers suitable for the use of the average family or small household.

GENERAL DETAILS.

In general the design combines efficiency in use with a pleasing outside appearance, sharp corners and projections have been obviated in every place. The supporting legs are of a pleasing curved design, and have domed feet which

Medium De-Luxe Cooker. No. HC. 206.

make the cooker easy to move about. The standard finish of the cookers is mottled grey vitreous enamel, but an alternative cheaper semi-black finish is also produced for each type of cooker.

Every care and attention has been devoted to both the mechanical and electrical design; in the former simplicity, accessibility, easy cleaning, combined with adequate strength has been the principal consideration, while in the latter every detail of the design and electrical equipment has been carefully considered and only the best materials have been used after careful research, and rigid inspection, so that efficiency and effectiveness in operation would result.

The cooker comprises a cooking top, in which are arranged the boiling plates and grill hotplate, a warming cupboard immediately below the top, and an oven. The control chamber is at the side of the cooker, and is compactly arranged as an integral part of the whole design.

Hotplates.

The hotplates are easily removable, and are supported on a frame under the hob in such a manner that the weight of the cooking utensils is, at all times, taken by the frame, and not by the electrical contact pins and sockets. The plates are also adjustable, so that their top surface is just above the level of the hob. This is obtained by means of screws which can be locked in position after the adjustment has been made.

Small De-Luxe Cooker. No. H.C. 204.

Another interesting feature is the provision of a grill hotplate instead of a grill only. This increases the usefulness of the cooker. When this plate is used for boiling only, a removable reflector is placed under the heating element to deflect the heat upwards. A close mesh wire grid is fitted under the grill hotplate for the mechanical protection of the heating elements. The hotplates, supporting frames and the grill side frames are all easily removable for cleaning.

Hotplate Housings and Oven.

Each hotplate housing, which contains the wiring and contact pins, is provided with a hinged wire handle by means of which it can be removed for cleaning. Special attention has been devoted to the design of the housings to minimise the collection of anything spilt over the hotplates during cooking. The warming cupboard, between the underside of the hob and the top of the oven, extends the full width of the oven. It has a drop down door which, when closed, is held in position by a spring. Each cooker is, of course, provided with a white enamel crown plate.

The oven is built up from sheet steel pressings welded together to form a one-piece structure with easily cleaned rounded corners. It is assembled in such a way that steam from the cooking cannot penetrate into the lagging space. The oven is double cased, efficiently lagged with slag wool packing, and the interior of the lagging space is vitreous enamelled. The side-hinged door is provided with a simple, yet very effective, lever latch. Fixed in the door is a thermometer with its bulb recessed into the door lining to reduce the possibility of damage. It is further protected against breakage by a substantial guard. A very legible scale indicates, in addition, the degrees Fahrenheit, "cool," "moderate," "hot" and "very hot"; it is so arranged that the temperature can easily be read without having to stoop.

Included in the standard equipment of each oven is one drip or meat tin, two grid shelves, and one sheet shelf.

The Range Available.

The range of cookers comprises three types, each of which is provided in the two finishes, mottled grey vitreous enamel or semi-black.

The Medium De Luxe Cooker, H.C. 206, is suitable for the requirements of an average family with a margin for special occasions. Its equipment comprises the oven, warming cupboard, and cooking top. The latter includes one boiling plate, 8 in. diameter, and one 6¼ in. diameter with a grill hotplate 9 in. wide × 7½ in. deep. The H.C. 205 is similar except that it has only one boiling plate, 8 in. diameter. These cookers are suitable for from 5 to 8 people.

The second of the series is the Small De Luxe Cooker No. H.C. 204. This has a warming cupboard, a slightly smaller oven space, one 8 in. diameter hotplate, one 5½ in. diameter boiling plate, and a grill hotplate, 7 in. wide × 7½ in. deep. The model H.C. 203 is similar except that it has only one boiling plate, 8 in. diameter. These models are suitable for from 3 to 5 people.

The third type is a Cottage Cooker. In this model the switch chamber is arranged alongside the warming cupboard, instead of alongside the oven. It comprises in addition an oven, one boiling plate, 8 in. wide × 6 in. deep. and one grill hotplate, 9 in. wide × 7½ in. deep ; and is suitable for 2 to 4 people.

Electrical Equipment.

Throughout the range the switches are of the three-heat rotary pattern, with pointer key knobs to indicate low, medium and high degrees of heat. All connections are as simple as possible, and effectively insulated from the housings. All heating wire is connected to non-corrodible terminals in nickel or nickel-silver washers, and there is no loose wiring under the hob. Boiling plates are of the embedded type, and can be either cast iron or stainless steel, as required. The grill hotplate elements comprise spirals supported on rods of refractory material, interlaced so that at all switch positions the heat is spread evenly over the surface of the grill. The elements are on two levels, one near the underside of the plate, and the other a little lower. By this arrangement a higher efficiency is obtained when using the plate for boiling than is usually the case, while the speed of grilling is not appreciably reduced.

The ovens are heated on the sides and bottom, and all the elements are well protected against mechanical injury. The side elements are of the plug-in type firmly supported at the front by pegs welded to the oven sides ; they are inside the cooking chamber behind the removable pressed steel runners, and, along with the runners, are easily removable to permit cleaning of the interior after cooking. The bottom elements fit in a special housing under the cooking chamber, and as they are loaded to a low current density are not likely ever to need removal.

With each cooker is provided a carefully considered instruction card, which covers most of the average requirements of the housewife. The Company has, in preparation, an " English Electric " Cookery Book which will be sent out with each cooker supplied. This will contain in addition to the usual recipes full advice for the successful operation and maintenance of the " English Electric " cookers.

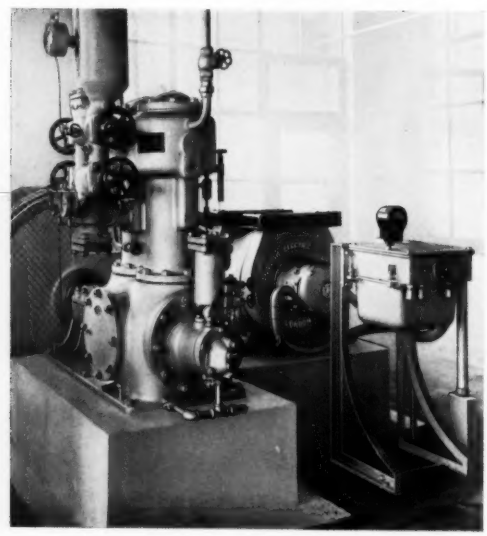
Cottage Cooker No. H.C. 201.

"English Electric" Motors.

Some New Developments.

Splash-proof Motors.

A sphere into which the electric motor is now rapidly penetrating is that of the agricultural and allied industries, such as, for example, milk distribution. Many dairies are now realising that in order to supply pure clean milk, economically and expeditiously, mechanical handling through the various processes of purification is essential. Nothing can assist in this so conveniently as the electric motor which can be mounted either as a part of the machine or as an extension of it. This, however, means that the motor and the driven machine are generally regarded as one complete unit, and the conditions under which the machine operates must also be withstood by the motor, without protection other than that afforded by the construction of the motor itself. In this industry the use of the hose for washing down most of the plant after operation is general,



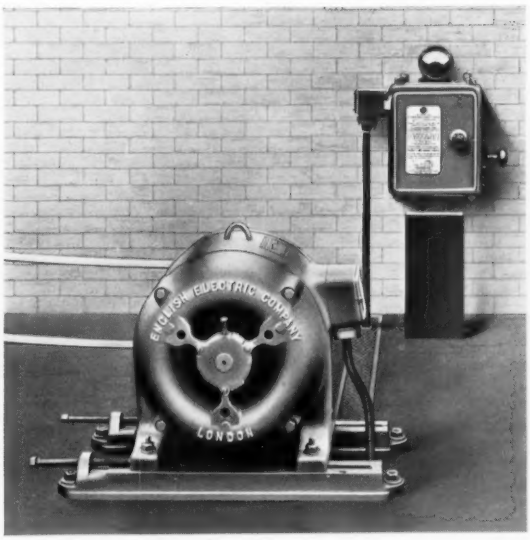
Compressor driven by Splash-proof Motor with "English Electric" Control Pillar.

Splash-proof Slipring Motor.

in order to preserve that scrupulous cleanliness so essential when dealing with food products. The "English Electric" alternating-current splash-proof motor has been designed for this and similar duties, where totally-enclosed machines would be too large and costly, and pipe ventilated machines impossible owing to the position of the motor relative to walls and other machinery. Its general construction is on similar lines to that of standard squirrel-cage or slipring motors for normal industrial service, but the openings which form the inlet and outlet for the ventilating air in this type of machine are at the top of the motor, and are protected by overhanging cowls of substantial construction. Adequate protection against the entry of any water which may be splashed against the motor is therefore provided without impeding the ventilating air; and the output of the motor is very similar to a standard protected machine of the same frame size.

Single Phase Squirrel-Cage Capacitor Motor.

The range of single-phase motors manufactured by the company has been extended beyond the fractional horse-power and split-phase machines



Capacitor Motor with Starter and Condensers.

by the addition of a line of capacitor motors. These single-phase machines are specially wound, for use with condensers of suitable capacity, to give a high starting effort. The condensers are in circuit during the starting and running periods, and the power factor is consequently high. The efficiency is also considerably higher than an ordinary single-phase motor.

In these capacitor motors the whole of the stator windings are also retained in circuit during running, and they operate therefore in practically the same manner as a polyphase machine with a rotating field, in place of the pulsating field which is usual in a single-phase motor. This feature and the absence of commutators and brush gear result in a motor which is far more silent than a repulsion induction motor, whilst the latter feature also ensures minimum radio interference. For these reasons the machines are particularly useful when a supply is changed from direct-current to alternating-current.

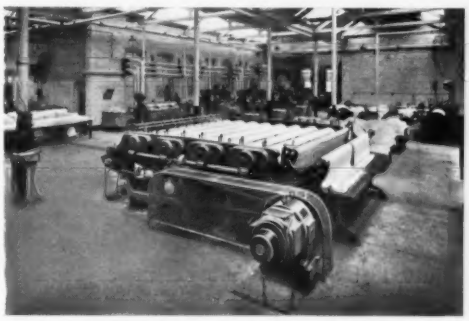
Variable Speed A.C. Commutator Motors.

The increasing use of three-phase alternating-current and the relative stagnation in direct-current supply is responsible for the rapid development of the variable speed A.C. commutator motor, since the normal motors are essentially constant speed machines and their use as variable speed motors by inserting resistance is an inefficient alternative. A further compromise, the pole changing motor, is useful for certain specified duties where definite speeds only are required, but for infinitely varying speed within wide limits the variable-speed commutator motor stands supreme.

The " English Electric " range of commutator motors was designed to meet this need, and is capable of maintaining a practically constant speed at any one setting independent of the load. They have shunt characteristics, that is, for a definite brush setting the speed falls only by about 5 to 8 per cent. of the maximum speed from no load to full load.

An " English Electric " variable speed A.C. commutator motor is essentially an induction motor with the roles of stator and rotor reversed ; that is, the rotor is the primary element, and is connected to the supply through sliprings, whilst the stator is the secondary. A small regulating winding, connected to a commutator in the same way as a D.C. armature winding, is wound in the same slots as the main rotor winding.

Two sets of brushes are provided on the commutator, and both ends of each stator phase are brought out and connected to the appropriate brush spindles, one on each rocker. The two rockers are geared together, so that they are moved in opposite directions, thereby varying the speed of the motor, when the regulating hand-wheel is turned. Remote control, with the rockers moved by a pilot motor which is con-



" English Electric " Variable-Speed Motor driving Calender in Large Laundry.

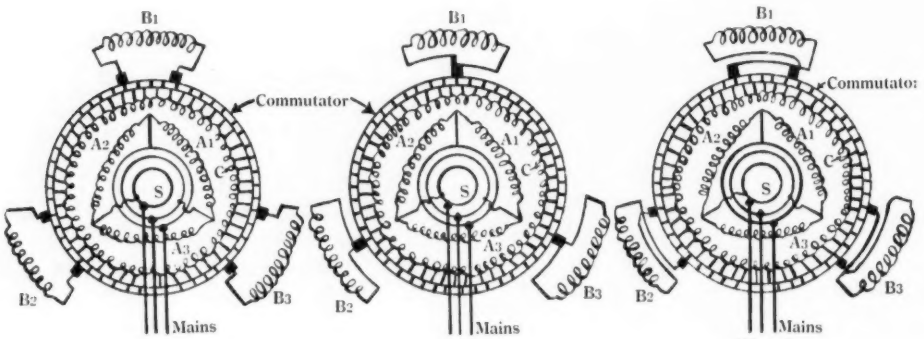


Fig. 1 Fig. 2 Fig. 3

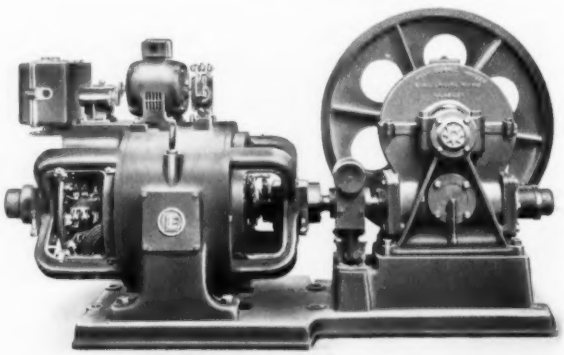
A Primary Winding on Rotor
B Secondary Winding on Stator
C Commutator Winding on Rotor
S Slip Rings

trolled by push-buttons, may also be used when desired.

The rotating magnetic field set up by the main rotor winding cuts the conductors of the regulating winding, inducing in them a voltage which is constant and independent of the speed of the motor. When the two brush spindles connected to each phase end are set in line with each other, the voltage generated in the regulating winding will have no effect, and the secondary winding will be short circuited, as on a normal induction motor; with the result that the motor will run at a speed corresponding to the frequency, number of poles and percentage slip (Fig. 2). If the two sets of brushes are now separated, a proportion of the alternating electromotive force induced in the regulating winding will be picked up, this depending on the number of bars embraced; that is, the distance they are spaced apart (Fig. 1). The rotation of the commutator converts the frequency of this E.M.F. from supply frequency to that of the slip E.M.F. already acting on the secondary. The two E.M.F.'s may be adjusted by bodily movement of the rockers until they are in phase with each other. If the E.M.F. of the regulating winding is added to that of the slip, then the motor will increase in speed until the balance of the voltage is just sufficient to drive the load current through the secondary resistance. By reversing the positions of the two rockers and thereby putting the two E.M.F.'s in opposition, the motor will slow down until a similar balance is restored. (Fig. 3).

These motors are particularly suitable for replacing direct-current variable-speed machines when a change-over takes place, as the speed control is so simple and in most cases only a straight-on switch is required.

(To be concluded.)



Enclosed-Ventilated Type Motor for High-Speed Passenger Lift Service; with Motor-Operated Brush Gear and Internal Sliprings.

THE CENTRAL ELECTRICITY BOARD USE D.P. BATTERIES

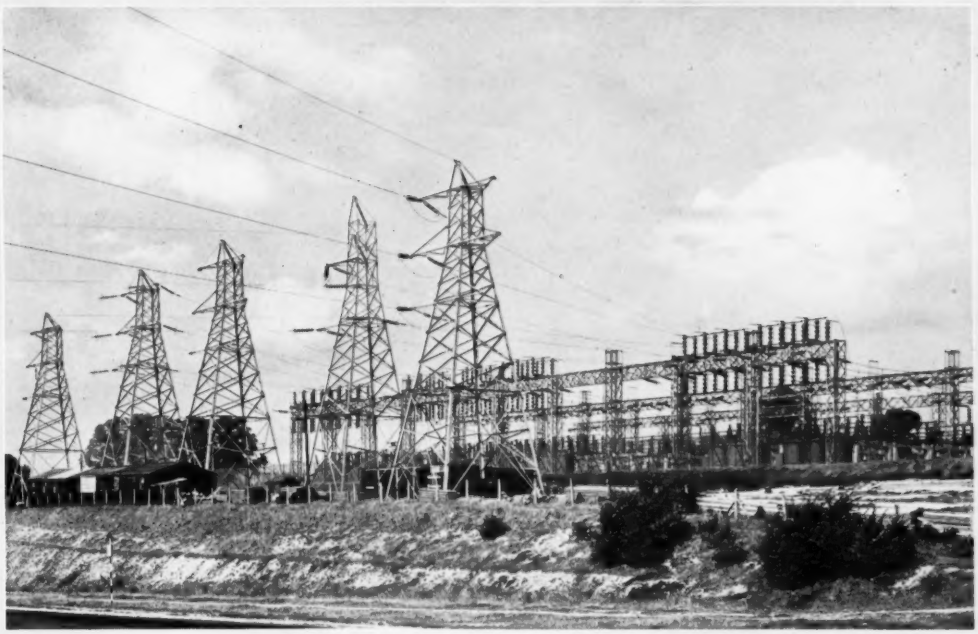


Photo by courtesy of The English Electric Co., Ltd.

SWANSCOMBE SWITCHING STATION

The largest 132 kV Switching Station of the "Grid," linking the London area with the systems in Kent and Sussex. A D.P. Battery is installed here.

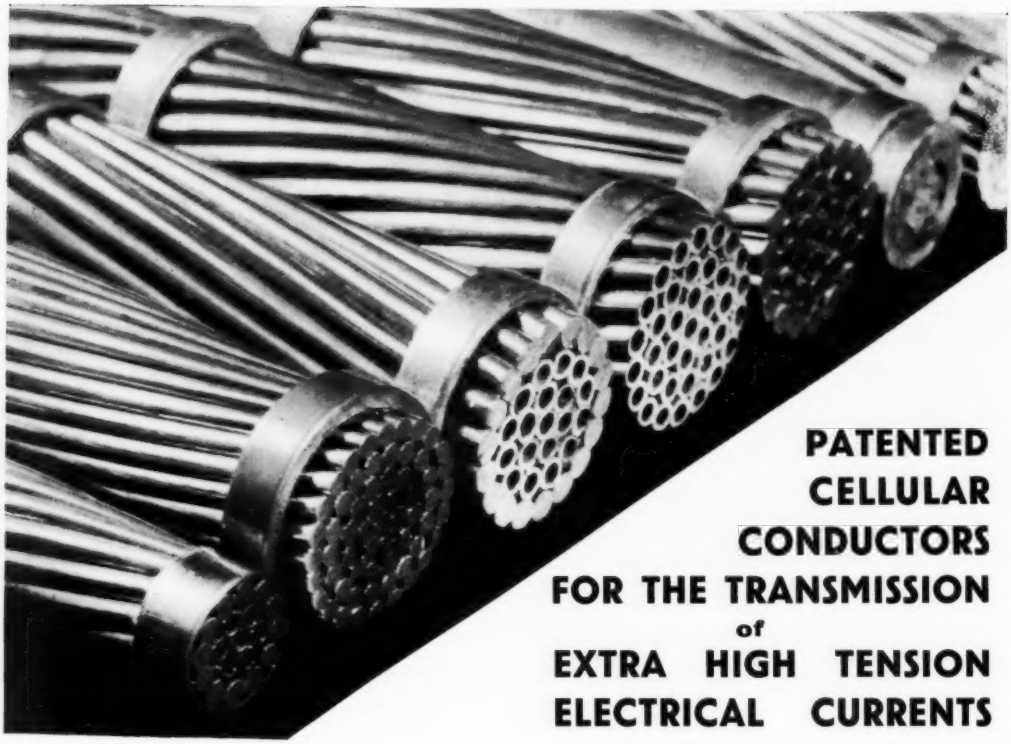
Altogether 19 D.P. Batteries have been ordered by the C.E.B. for use in connection with the "Grid" system at the following places:

CLYDES MILL
PAISLEY
GREENOCK
KILMARNOCK
BRIGHTON (Portslade)
EASTBOURNE
HASTINGS
FOLKESTONE (Shorncliffe)
ELTHAM
SWANSCOMBE (Northfleet)
MAIDSTONE
ALDERLEY EDGE
CHESTER
CANTERBURY
TUNBRIDGE WELLS
TONGLAND
GLENLEE
GALASHIELS
DUMFRIES

THE D.P. BATTERY COMPANY LTD., BAKEWELL, DERBYSHIRE

LONDON :— 50 GROSVENOR GARDENS, S.W.1

J51.



PATENTED CELLULAR CONDUCTORS FOR THE TRANSMISSION of EXTRA HIGH TENSION ELECTRICAL CURRENTS

THESE conductors combine the high tensile strength of certain copper alloys of low electrical conductivity with the high conductivity of copper or cadmium copper.

They have been specially introduced for the transmission of extra high tension electrical currents and, among other purposes, have been used at the Central Electricity substations for transforming 132,000 volts to working pressures for main distribution.

They are of particular value for transmission lines since they allow spans nearly 50% greater than is possible with steel cored aluminium lines and are superior in every respect.

By varying the component metals these conductors can be made to suit individual requirements.

The Requirements of the Electrical Industry are catered for by —

'BOLTON' COPPER PRODUCTS

ESTABLISHED 1783

Thomas BOLTON & Sons Ltd

London Office:
168 Regent Street
W.1

Head Office:
Mersey Copper Works
WIDNES

CRAVEN

GEAR UNITS

FOR A.C. SUPPLY

We build a complete range of reduction units, suitable for all types of Industrial Drives and heavy vehicle transmission, the worm reduction units in this range being fitted with the famous "Craven-Guest" Hollow-Face Worm Gear.

Motorised or standard units are available in multi-speed, single-reduction, or worm reduction Boxes.

Write for Brochure N.S.26.

The "Craven-Guest" Worm Gear gives the following definite advantages :—

- Contact on full length of worm thread.
- Greater length of worm.
- Larger area of wheel contact.
- Greater wheel tooth strength.
- Oil always carried to area of contact.
- Improved rolling action.
- Highest efficiency over speed range.

CRAVEN BROTHERS (MANCHESTER) LTD.

Incorporating

SIR W. G. ARMSTRONG WHITWORTH & CO., LTD. (Machine Tool Dept.).
CRAVEN BROS. (Manchester) LIMITED.
THOMAS SHANKS & CO. (1928) LIMITED.
JOSHUA BUCKTON & CO. LIMITED.

REDDISH, STOCKPORT.

SPUR
REGISTERED TRADE MARK

OILS

SPUR
REGISTERED TRADE MARK

"SPUR" Transformer, Turbine, and Diesel Engine Oils.
"SPUR" Lubricating Oils for all classes of Machinery.
"SPUR" Refrigerator and Gas Engine Oils.
"SPUR" H.M. Insulating Oil for Switchgear.

Contractors to the English Electric Co., and to other leading Industrial Concerns, Government Departments and Municipalities.
Deliveries can be made in ROAD or RAIL TANK CARS or PORTABLE TANKS, as well as in Barrels and Drums.

FURTHER INFORMATION FROM:

SPURRIER, GLAZEBROOK & CO., LTD.,
8, MARKET PLACE, MANCHESTER 4.
Works. & Laboratories: Worsley Street, Salford 3.

PACKINGS & JOINTINGS

by SPECIALISTS

MOULDED RUBBER VALVES
Walker's Mechanical Rubber Goods have a reputation for reliability and are confidently recommended.

"LION" FABRIC CUPS
For Hydraulic work. Composed of reinforced fabric and recommended to replace leathers.

"LION" JOINTS
Universally popular for Manhole and Mudhole Doors, etc. Many thousands supplied annually.

WALKER'S LION PACKING

ENQUIRIES INVITED.
Write for Catalogue No. 215 to :—

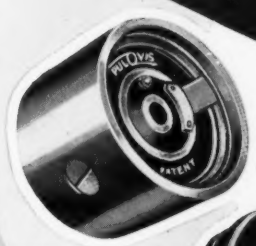
JAMES WALKER Co., Ltd.,
"LION" WORKS, WOKING, SURREY.
PHONE: WOKING 1040. *GRAMS: LIONCELLE.*

Eliminate Clutch Troubles & losses by adopting —

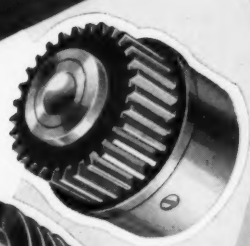
The PULVIS CLUTCH

The Perfect Power Medium for all Classes of Machinery!

Made in different forms to suit various types of drive



BELT DRIVE



DIRECT GEAR DRIVE

COUPLING TYPE

TEXROPE DRIVE

ADVANTAGES.

Saving in First Cost.
Reduced Running Power Costs.
Minimum Attention and Lubrication.
Automatic Overload Protection.
Reduced Power Demand on Starting.
Maintenance Costs Practically Eliminated.

TYPICAL USES.

Compressor Drives, Woodworking Machines, Fans, Separators, Line Shaft Motors, Punches, Shears, Metal Sawing Machines, Turntables, Crushes, and most classes of drive for starting up against load, or where the driving unit has small overload capacity.

Send for descriptive pamphlet:—

THE BRITISH REMA MANUFACTURING CO., LIMITED,

Well Royd Works, HALIFAX.

ASSOCIATED BRITISH MACHINE TOOL MAKERS LTD.

17, GROSVENOR GARDENS. LONDON, S.W.1.

ABMTM TOOLS COVER THE MANUFACTURING WORLD

The A.B.M.T.M. group of machine-tool makers covers the whole field of machine-tool building, giving the engineer at home and abroad a unique manufacturing and sales service.

Apart from the main specialities of the Associated firms, as given below, customers have the advantages of the pooled research, the accumulated experience and the entire technical resources of the whole group.

The abundant advantages thus provided by group co-operation will be obvious. The after-sales service provided is of a kind beyond the scope of the single manufacturer.

THE MAIN SPECIALITIES of the Associated Firms are as follows:

Drilling Machines.	James Archdale & Co., Ltd., Birmingham. Wm. Asquith Ltd., Halifax.
Lathes.	John Lang & Sons Ltd., Johnstone, Scotland.
Boring Machines and Boring Mills.	Wm. Asquith Ltd., Halifax. George Richards & Co., Ltd., Manchester.
Gear Cutting Machines.	J. Parkinson & Son, Shipley, Yorks.
Grinding Machines.	The Churchill Machine Tool Co., Ltd., Manchester.
Turret and Capstan Lathes.	H. W. Ward & Co., Ltd., Birmingham.
Planers, Slotters, etc.	The Butler Machine Tool Co., Ltd., Halifax.
Plano Millers **Screwing Machines**	Kendal & Gent Ltd., Manchester.
Milling Machines.	J. Parkinson & Son, Shipley. Jas. Archdale & Co., Ltd., Birmingham.

For further particulars write to:

17, GROSVENOR GARDENS

LONDON——————S.W.1

INDEX TO ADVERTISERS

Alfa-Laval Co., Ltd. V
Associated British Machine Tool Makers, Ltd. XVI
Attwater & Sons IV
Bolton, Thomas & Sons Ltd. XII
British Rema Mfg. Co., Ltd., The XV
Broadbent, Thos. & Sons, Ltd. III
Craven Brothers (Manchester), Ltd. XIII
D. P. Battery Co., Ltd. XI
English Electric Company Limited XVII
Hall Bros. (West Bromwich) Ltd. IV
London Electric Wire Co. & Smiths Ltd. II
Mason, E. N., & Sons, Ltd..... VIII
Micanite & Insulators Co., Ltd. VII
Midland Steel Co., Ltd. IX
Siemens Brothers & Co., Ltd. X
Silvertown Lubricants Ltd. VI
Spurrier, Glazebrook & Co., Ltd. XIV
Straker Brothers Ltd. XVIII
Taylor, Tunnicliff & Co., Ltd. V
Tube Products Ltd. IX
Walker, James & Co., Ltd.... XIV
Westinghouse Brake & Saxby Signal Co., Ltd. II
Yorkshire Copper Works Ltd. I

All communications respecting Editorial Contents and Advertising Rates should be addressed to The Editor, The English Electric Journal, The English Electric Company Limited, Stafford.

When communicating with Advertisers please mention English Electric Journal.

ENGLISH ELECTRIC FIRES

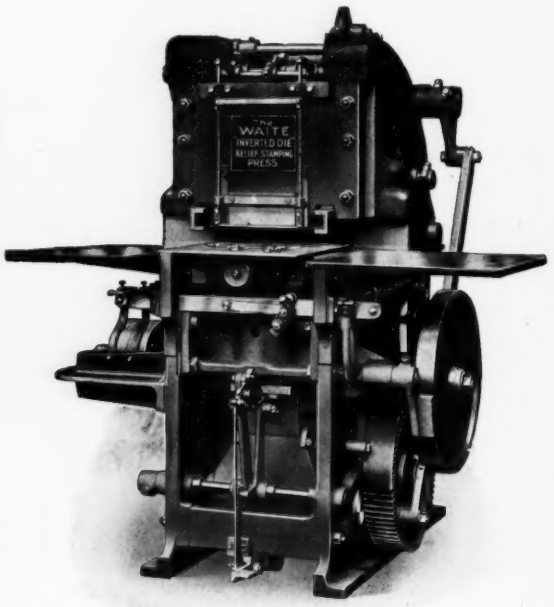
PERMANENT VITREOUS ENAMEL FINISH
WIDE RANGE OF COLOURS

1 KILOWATT SIZE
16/-
Uses one unit per hour

2 KILOWATT SIZE
24/6
Uses one or two units per hour

Supply Undertakings and Wholesalers should apply to the Domestic and Heating Section, Bradford, for Publication N.47a, and Trade Terms.

ENGLISH ELECTRIC COMPANY LTD.
Queen's House, Kingsway, London, W.C.2.
Works: STAFFORD, BRADFORD, RUGBY, PRESTON.



Power Relief Press for Die Stamped Headings

STRAKER BROTHERS LTD.

SPECIALISTS IN DIE STAMPED LETTER HEADINGS

DESIGNING & ENGRAVING
OF EVERY DESCRIPTION

TENDER COVERS & BINDERS FOR ALL PURPOSES

FINE ART, CATALOGUE & COLOUR PRINTING

THE BISHOPSGATE PRESS,
194-200, BISHOPSGATE,
LONDON, E.C.2

TELEPHONE:
BISHOPSGATE 2444